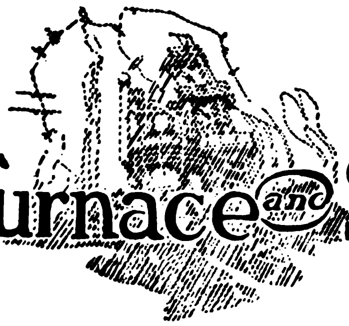


The Blast Furnace and Steel Plant

Published the first of each month by the National Iron and Steel Publishing Co.

Main Office — Thaw Building, 108 Smithfield Street, Pittsburgh.

DISTRICT OFFICES — NEW YORK AND CHICAGO.

President: H. A. Andresen. Vice President and Treasurer: F. C. Andresen. Secretary: M. M. Zeder.
Engineering Editor: ALFRED M. STAEHLE. Associate Editor: A. W. PETERSON.

EDITORIAL ADVISORY BOARD:

William A. Field
W. Trinks
Fred Crabtree
Kenneth B. Lewis
Barton R. Shover
Dr. George B. Waterhouse
E. H. McClelland
A. G. Smith

Subscription Price:—In the United States, $1 per year; Canada, $1.50; all other countries, $2. Single Copy, 15 Cents.
Entered as second-class mail matter at Pittsburgh, Pa., under the Act of Congress, March 3, 1879.

Index to Contents

VOL. VII. FEBRUARY, 1917. NO. 2

THE JAPANESE IRON AND STEEL INDUSTRY 89

EXISTING BY-PRODUCT COKE OVEN ENLARGED 95

HEATING FURNACES AND ANNEALING FURNACES—PART II 98
BY W. TRINKS.

STEEL PLANT INDUSTRIAL RELATIONS STUDIED 101

REVIEW OF TECHNICAL LITERATURE FOR 1918 105

PIG IRON STATISTICS 110

PRINCIPLES OF OPEN HEARTH FURNACE DESIGN—PART III 111
BY CHARLES H. F. BAGLEY.

A REVIEW ON THE USE OF POWDERED COAL 114
BY W. O. RENKIN.

SOME POINTERS ON BY-PRODUCT COKE OVEN OPERATION 117

INDUSTRIAL RELATIONS 118

PRODUCTION TOPICS 119

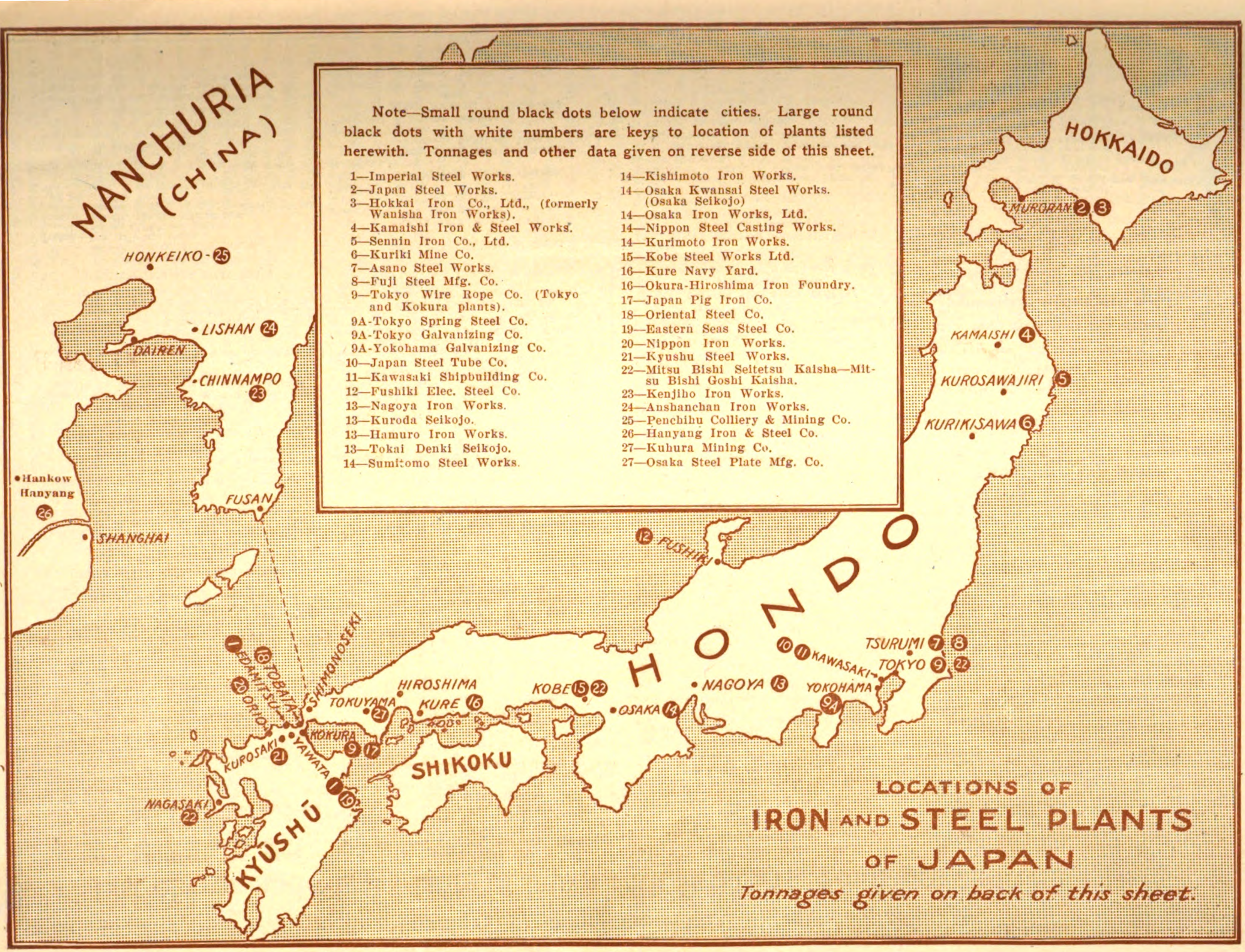
OPEN HEARTH 120

FOREIGN RELATIONS 123

WITH THE EQUIPMENT MANUFACTURERS 123

NEWS OF THE PLANTS 124

TRADE NOTES, TRADE PUBLICATIONS, SOCIETY MEETINGS, OBITUARY 68



Note—Small round black dots below indicate cities. Large round black dots with white numbers are keys to location of plants listed herewith. Tonnages and other data given on reverse side of this sheet.

1—Imperial Steel Works.
2—Japan Steel Works.
3—Hokkai Iron Co., Ltd., (formerly Wanisha Iron Works).
4—Kamaishi Iron & Steel Works.
5—Sennin Iron Co., Ltd.
6—Kuriki Mine Co.
7—Asano Steel Works.
8—Fuji Steel Mfg. Co.
9—Tokyo Wire Rope Co. (Tokyo and Kokura plants).
9A-Tokyo Spring Steel Co.
9A-Tokyo Galvanizing Co.
9A-Yokohama Galvanizing Co.
10—Japan Steel Tube Co.
11—Kawasaki Shipbuilding Co.
12—Fushiki Elec. Steel Co.
13—Nagoya Iron Works.
13—Kuroda Seikojo.
13—Hamuro Iron Works.
13—Tokai Denki Seikojo.
14—Sumitomo Steel Works.
14—Kishimoto Iron Works.
14—Osaka Kwansai Steel Works. (Osaka Seikojo)
14—Osaka Iron Works, Ltd.
14—Nippon Steel Casting Works.
14—Kurimoto Iron Works.
15—Kobe Steel Works Ltd.
16—Kure Navy Yard.
16—Okura-Hiroshima Iron Foundry.
17—Japan Pig Iron Co.
18—Oriental Steel Co.
19—Eastern Seas Steel Co.
20—Nippon Iron Works.
21—Kyushu Steel Works.
22—Mitsu Bishi Seitetsu Kaisha—Mitsu Bishi Goshi Kaisha.
23—Kenjiho Iron Works.
24—Anshanchan Iron Works.
25—Penchihu Colliery & Mining Co.
26—Hanyang Iron & Steel Co.
27—Kuhura Mining Co.
27—Osaka Steel Plate Mfg. Co.

LOCATIONS OF
IRON AND STEEL PLANTS
OF JAPAN

Tonnages given on back of this sheet.

O.k.

List of Iron and Steel Plants of Japan with Products, Tonnages and Other Data

1 IMPERIAL (GOVERNMENT) STEEL WORKS

Yawata and Edamitsu, Fukuoka-ken, Kyushu

Mr. Oshikawa, director general.
Mr. Takeshi Shirani, chief engineer.
Product—Plates, galvanized sheets, rails, shapes, bars and heavy forgings.
Present capacity, 300,000 tons.
Expected capacity, 650,000 tons.
Present Plant Equipment—
3 blast furnaces of 210 tons per day each
1 blast furnace of 270 tons
12 Siemens-Martins basic O.H. furnaces (25 tons)
6 Siemens-Martins basic O.H. furnaces (50 tons)
8 Siemens-Martins basic O.H. furnaces (60 tons)
2 200 ton Talbot mixers
2 Bessemer converters (10 tons)
150 coke ovens of 1000 tons per day capacity
1 15-ton acid furnace
4 1-ton crucibles
New Equipment in contemplation:
1 new blast furnace (250 tons capacity) to be built in 1919 and completed in 1923.
New plate mill (to roll boiler plate)
Also new steel plant of 120,000 tons per year planned.
Ore comes from Tayeh mines, China and Korea. Company owns its own coal mines which supply about one-half of needs.

2 JAPAN STEEL WORKS—Nippon Seikosho

Main Office Tokyo,

Plant at Muroran, Hokkaido

Owned by Sir W. G. Armstrong, Whitworth & Co., Vickers, Ltd., of Sheffield and Hokkaido Tanko Kaisen.
Product—Steel castings and gun forgings. Swedish pig iron and British and American hematite ore used.
Present capacity 60,000 tons
Present equipment—2 50-ton acid O.H. furnaces
2 25-ton acid O.H. furnaces
2 25-ton basic O.H. furnaces
2 5-ton basic O.H. furnaces

3 HOKKAI IRON CO., LTD.,

(Formerly Wanisha Iron Works)

Hokkaido Tanko Kaisen

Owned by Mitsui & Co. and Sir. W. G. Armstrong, Whitworth & Co. and Vickers, Ltd. of Sheffield, England

(Hokkaido, near Muroran)

Product—Pig iron.
Ore comes from Tayeh mines in China and Mitsui & Co.'s mines in Korea.
Present capacity, 30,600 tons per year.
Expected capacity, 90,000 tons per year.
Present equipment, 1 blast furnace 90-ton capacity.
Contemplated equipment, 2 new furnaces of 100 tons capacity to be installed during 1919.

4 KAMAISHI IRON AND STEEL WORKS

Kamaishi, Iwate-ken, Hondo

Chobei Tanaka, director general.
Product—Bars, rails and angles.
Present capacity, 80,000 tons steel.
Expected capacity, 159,800 tons per year.
Present equipment, 7 blast furnaces; produces 230 tons of pig iron per day.
New equipment, 2 new furnaces of 120 tons each will be built during 1919.
Also in present equipment, 2 7½-ton basic O.H.
2 9-ton basic O.H.
Contemplated additional capacity:
4 25-ton basic O.H. furnaces.
(Have own iron ore mines)

5 SENNIN IRON CO., LTD.

Iwasaki Village, near Kurosawajiri, Iwate-ken, Hondo.
Product—Pig iron. Capacity—3,796 tons.
Equipment—I furnace 10 tons. Have own iron ore.

6 KURIKI MINE CO.

Kurikisawa, Kisen-gori, Iwate-ken, Hondo.

Product—Pig iron. Capacity—2500 tons.
Equipment—2 furnaces of 3 tons per day.
(Have own iron ore mines)

7 ASANO STEEL WORKS

Proposed capital, $2,500,000.
Steel works to be built at Tsurumi near the new Asano Ship Building Company, controlled by Toyo Kisen Kaisha Co.
Expected capacity, 50,000 tons per year of ship plates.
Machinery to be bought in Japan.

8 FUJI STEEL MFG. COMPANY

(Fuji Seiko Kaisha)

Plant to be built at Tsurumi, near Yokohoma.
Capital, $2,500,000.

9 TOKYO WIRE ROPE COMPANY

Oshima Plant at Tokyo

Product—Iron rope.
Capacity, 12,600 tons steel.
Present equipment, 10 2-ton acid O.H. furnaces.

Kokura Plant at Kyushu

Product, Wire rope. Capacity, 36,000 tons.
Present capacity, 25 2-ton basic O.H. furnaces.

9A TOKYO SPRING STEEL CO.

Capacity, 29,000 tons.
1 Electric furnace.
1 Crucible furnace.
4 O.H. furnaces.

9A TOKYO GALVANIZING PLANTS

Works at Osaka, Tokyo and Yokohoma.

9A YOKOHOMA GALVANIZING CO.

(Yokohoma Aen Mekki Kabushiki Kaisha)

Plant at Tokyo Yokohoma.

10 JAPAN STEEL TUBE CO.

(Nippon Kokwan Kaisha)

Kawasaki, Kanagawa-Ken, halfway between Tokyo and Yokohoma.

Capital, $2,500,000.
Product—Steel tubes, bars, angles, wire rods, structural material.
Present capacity, 50,000 tons.
Contemplated capacity, 100,000 tons.
Present equipment, 2 25-ton basic O.H. furnaces.

11 KAWASAKI SHIPBUILDING (Dockyard) Co.

Kawasaki, Kanagawa-Ken.

Product, bars and ship plates.
Present capacity, 20,000 tons.
Present equipment, 1 15-ton basic O.H. furnace.
1 5-ton basic O.H. furnace.

12 FUSHIKI ELECTRIC STEEL CO.

To be built at Fushiki, Province Etchu Hondo.
Subsidary of Japan Steel Tube Co.
Capital, $2,500,000. Capacity, 30,000 tons.
Electric furnace steel.

13 TOKAI DENKI SEIKOJO In Nagoya

Capacity, 360 tons.

13 NAGOYA IRON WORKS (Nagoya)

Capacity, 6 tons high speed steel.

13 KURODA SEIKOJO (Nagoya)

Capacity, 1-3 ton.

13 HAMURO IRON WORKS (Nagoya)

Capacity, ½ ton.

14 NIPPON STEEL CASTINGS WORKS

Plants at Osaka and Tokyo.

Capacity, 900 tons.
Equipment, 2 Bessemer converters.

14 OSAKA KWANSAI STEEL WORKS

Osaka Seikojo

Capacity, 200 tons.
Equipment, 1 Bessemer convereer.

14 OSAKA IRON WORKS, LTD.

(Osaka Steel Works)

(Osaka Seitetsu Kabushiki Kaisha)

Capital, $2,500,000.
Product—Bars, angles, tees and channels.
Capacity, 12,000 tons.
Equipment, 2 15-ton basic open hearth furnaces.

14 KURIMOTO IRON COMPANY (Osaka)

14 SUMITOMO STEEL WORKS (Osaka)

Product—Steel castings and forgings.
Present capacity, 30,000 tons.
Present equipment, 2 15-ton basic O.H. furnaces.
1 5-ton acid O.H. furnace.
Contemplated equipment, 1 15-ton O.H. furnace.

14 KISHIMOTO IRON WORKS (Osaka)

Product—Rails.
Present capacity, 18,000 tons.
Present equipment, 2 25-ton Siemens-Martins O.H. furnaces.

15 KOBE STEEL WORKS LTD.

(Suzuki & Company)

(Kobe)

Product—Steel castings and steel forgings.
Present capacity, 20,000 tons; alloys, 2,000 tons.
Present equipment, 1 15-ton basic O.H. furnace.
1 25-ton basic O.H. furnace.
1 5-ton basic O.H. furnace.

16 OKURA-HIROSHIMA IRON FOUNDRY

Kure, Hiroshima-Ken, Hondo.

16 KURE NAVY YARDS

Kure, Hiroshima-Ken, Hondo.

1,000 tons per year high speed steel.
2,400 tons per year boiler plate.

17 JAPAN PIG IRON COMPANY

Nippon Sentetsu Kaisha.

(Kokura, Kyushu)

Capital, $750,000. Product, pig iron.
Owners, The Tokyo Wire Rope Co.

18 ORIENTAL STEEL COMPANY

(Toyo Seitetsu Kaisha)

Tobata, Fukuoka-Ken, Kyushu.

B. Nakano, president; Nagabumi Ariga, auditor.
Capital, $20,000,000.
Product—Pig iron.
Present equipment, 1 15-ton blast furnace.
Expected capacity, 170,000 tons per year.
Contemplated equipment, 2 blast furnaces of 250 tons capacity each. Also steel plant.

19 EASTERN SEAS STEEL COMPANY

(Tokai Kogyo Kaisha)

Main office, Tokyo. Plant at Yawata Kyushu.
Capital, $1,500,000.
Plate mill capacity, 40,000 tons.

20 NIPPON SEITETSU KABUSHIKI KAISHA

(Nippon Iron Works, Limited)

Orio (near Wakamatsu), Kyushu.

N. Kishimoto (Osaka), president.
Capital, $1,500,000.
Present equipment, 1 50-ton blast furnace.
Contemplated capacity, 1 120-ton blast furnace and later steel plant.

21 KYUSHU STEEL WORKS (Chino-Japan Iron Corp)

(Yasukawa & Co.)—Kurosaki, Kyushu.

Keichiro Yasukawa, president.
Capital, $5,000,000.
Equipment, 3 50-ton basic O.H. furnaces.
1 Structural mill.
1 Plate mill.
Pig iron from Hanyehping, China.

22 MITSU BISHI (Dockyard) Co.

Mitsu Bishi Seitetsu Kaisha—Mitsu Bishi Goshi Kaisha.

Main Office, Tokyo; Plants at Kobe & Nagasaki.

Mr. Y. Wakahayshi, general manager. Mr. Kawamura, Mr. Y. Uyematsu.
Present capacity, 36,000 steel.
Present equipment, 2 7-ton acid open hearth.
1 2-ton acid O.H.
Contemplated capacity, 60,000.
Equipment, 2 Bessemer converters.

23 KENJIHO IRON WORKS

(Near Chinnampo, Northern Korea)

Owned by Mitsu Bishi Co.
Capital, $3,000,000.
Product—Pig iron, ship plates, sheets, bars, angles.
Present capacity, 102,000 tons.
Present equipmnt, 2 blast furnaces at 150 tons each, also steel plant.

24 ANSHANCHAN IRON WORKS

Lishan, Manchuria, 196 Miles West of Dairen.

Owned by S. Manchuria Railway Co. Mr. Kido, chief eng.
Capacity, 150,000 tons pig iron.
Equipment, 2 250-ton blast furnaces.
Contemplated equipment, steel plant with capacity of 130,000 tons.

25 PENCHIHU COLLIERY & MINING CO.

Honkeiko, (Manchuria)

Penchihu, near Liao Yang (Mukden).

Product—Pig iron.
Present capacity, 44,200 tons.
Expected capacity, 88,400 tons.
Present equipment, 2 blast furnaces of 130 tons.
Contemplated additional equipment, 1 blast furnace, 130 tons now being installed. Also steel plant.

26 HANYEHPING COAL & IRON COMPANY

Near Hankow, China.

26 HANYANG IRON & STEEL COMPANY

Near Hankow, China.

Officials—Mr. Y. T. Yen, Dr. Z. T. K. Woo, Mr. C. I. Huang, Mr. Y. I. Chen.
Product—Pig iron.
Capacity, 400,000 tons.
Present equipment, 1 100-ton blast furnace.
1 200-ton blast furnace.
Contemplated equipment, 2 400-ton blast furnaces.

27 KUHURA MINING COMPANY

Contemplated site, Tokuyama.

Expect to build a large ship building yard and steel works and spend in the neighborhood of $50,000,000.

27 OSAKA STEEL PLATE MFG. COMPANY

Tokuyama.

TSUCHIHASHI ELECTRIC STEEL WORKS

Three electric furnaces.
Annual capacity, 900 tons.

NIPPON SPECIAL STEEL COMPANY

Capacity 4,800 tons.
1 crucible furnace.

YASUKI STEEL FACTORY

1,200 tons per year high speed steel.

YONAKO STEEL FACTORY

2,000 tons per year high speed steel.

OJI DENKI SEITETSUJO

600 tons per year high speed steel.

OMORI SPECIAL STEEL MFG. CO.

1,200 tons per year high speed steel.

NITTO SEIKO KABUSHIKI KAISHA

3,600 tons per year high speed steel.

TOKYO KOZAI KABUSHIKI KAISHA

3,000 tons per year high speed steel.

URAGA DOCKYARD.

Capacity, 600 tons. Equipment, 1 Bessemer open hearth.

NITTO STEEL WORKS.

Present capacity, 600,000 tons.
Equipment, 1 12-ton basic O.H. furnace.
Contemplated equipment, 1 5-ton basic O.H. furnace.

Supplement to the Blast Furnace and Steel Plant, February, 1919.

The Blast Furnace and Steel Plant

VOL. 7. PITTSBURGH, PA., FEBRUARY, 1919. NO. 2.

The Japanese Iron and Steel Industry

Report Upon the Iron and Steel Industry in Manchuria and Korea and Also Upon the Possibility of Japanese Future Independence in the Production of Iron and Steel.

Iron and Steel has proven itself to be the very foundation of the strength of any nation. No country realizes this more fully than Japan. Although naturally deficient in mineral resources this country has made and is making great strides in developing her iron and steel industry. The sudden embargo of American steel did much to accelerate the growth of the industry. While the ban did cause temporary inconvenience to the Japanese industries the effect thereof was not entirely harmful. Dr. Koroku Kamura in commenting upon the situation at that time said, "Both government and people are forced to the necessity of making better provisions for the manufacture of steel at home. If this can be accomplished it will prove the greatest blessing brought to Japan by the war." This opinion really sounds the keynote of the situation of the Japanese iron and steel industry. This country is and will continue to strive to make that industry independent. At present it is far from this ideal, but insofar as it is possible to work the resources of Manchuria and China the Japanese industry may at some future time approach a state of independence. Statistics are not very assuring if referred to the resources of Japan alone, nor are they so if production and demand figures are compared. But against these statistics must be discounted the fact that the industrial growth of Japan will probably be very great. There is no denying the fact that Japan is developing and this development is guided by an ambitious people and government who dream of achieving the "splendid isolation" of Great Britain.

Probably no nation in the world is more ambitious than Japan. She fully realizes that the foundation of industrial independence means first of all, independence in iron and steel. Although naturally deficient in mineral resources the Japanese have been working with great energy to develop the metals on their own islands, and in their colonies. Special concessions and privileges in the mining of Chinese deposits have been secured. The estimated annual requirements of iron and steel in Japan are 2,500,000 tons, which was only met to the extent of 800,000 during 1918. The ideal of the Japanese is to attain independence and to this end her extension plans call for a capacity production of over 1,500,000 tons by 1923.

As a result of a recent investigation for a foundry site and prospective iron mining field at Anshan-tien, two officials of the Imperial Railway Board, Mr. Suziki, an engineer, and Mr. Goshima, prepared an exhaustive report upon the iron industry in Manchuria and Korea and also upon the possibility of Japan's future independence in the production and manufacture of iron and steel. This report is given publicity in an issue of the "Far Eastern Review," from which the following is taken:

By way of calling attention to the need of a study of the iron problem, these two officials preface their report with statistics showing the increased consumption of iron in Japanese manufactures as compared with the output and they then contrast Japan's output and iron manufactures with those of other nations. Their figures are largely taken from a report of the Iron Foundry Investigation Society and are undoubtedly sufficiently disconcerting to those Japanese who believe that all civilizations, and particularly their civilization, power, prosperity and prestige, are founded upon mining and metals.

It is argued, for instance, that since the demand for pig iron increased from 59,996 tons in 1903 to 224,309 tons in 1913, the demand, which has been growing proportionately, will be 360,900 tons this year and 533,800 tons in 1923. The demand for steel in 1903 was 286,479 tons and in 1913, 748,056 tons; while the estimated demand for this year will be 1,113,086 tons, and in 1923, 1,568,000. These figures do not include the tonnage of imported steel manufactures such as ships, machinery, railway cars and engines which formerly averaged about 92,000 tons a year. It is believed that including manufactured imports the demand for steel in Japan will be 2,193,000 tons in 1923.

Against these figures the officials of the railway board estimate that the output of pig iron and steel in Japan and Manchuria in the various existing works is as follows:

Yedamitsu Iron Works (steel)	281,977 tons
Kamaishi (pig-iron and steel)	57,425 tons
Wanishi (pig-iron)	29,970 tons
Sennin	3,796 tons
Kuriki	2,857 tons
Penchihu	45,000 tons
Total	423,025 tons

This total is something less than a quarter of the estimated demand for 1918 and when these figures are contrasted with those which the Japanese officials produce for America and other countries, using statistics as old as those of 1913 and 1914, they make a very poor showing indeed. The following figures are given in the report:

The Total Production in 1914.

America, pig-iron	30,966,000 tons
America, steel	24,790,000 tons
Germany, pig-iron	19,300,000 tons
Germany, steel	18,950,000 tons
England, pig-iron	10,480,000 tons
England, steel	7,660,000 tons
Russia, pig-iron	4,540,000 tons
Russia, steel	3,960,000 tons
France, pig-iron	5,210,000 tons
France, steel	5,310,000 tons

The Total Production in 1913.

Belgium, pig-iron	2,500,000 tons
Austria-Hungary, pig-iron	1,670,000 tons
Canada, pig-iron	1,008,000 tons
Sweden, pig-iron	735,000 tons
Spain, pig-iron	409,000 tons
Italy, pig-iron	373,000 tons
Japan, pig-iron	235,000 tons

Commenting upon these figures, the officials of the railway board write as follows:

In point of the iron industry and production Japan is far inferior even to Spain or Italy. The importance of home supply of iron and independence of arms and ammunitions supply have been earnestly advocated for a long time by military officers and those people who are inspired by an economic imperialism. The present great European war, which has given various lessons to Japan, has made the Japanese awake and realize the urgent necessity of a home-supply of iron. Stimulated by these, every organization has been expanded and iron work enterprises in the interior, Chosen and Manchuria, have become prosperous. The time is now mature for them to see to the development of the iron industry. We will report the present condition of some of the chief iron works.

Government Iron Foundry at Edamitsu.

Production: 650,000 tons per year—The second extension having been almost completed in the fiscal year of 1916, the Edamitsu iron foundry is now capable of producing 350,000 tons of steel per year. Since the outbreak of the present European war, the great increase in demand for iron and the shortage of freight have made iron importation from foreign countries difficult and at the same time the home demand for iron has greatly increased. The present unsatisfactory state of the iron supply has prompted this foundry to increase the output of iron by as much as 650,000 tons; and in the thirty-seventh session of the Diet, convoked in 1916, a bill for an expenditure amounting to Y. 34,515,450 for the third extension was submitted and passed, and the construction work commenced in 1916, is now going on. Construction will be carried on for six consecutive years ending in 1921 when the work will be completed. The total expenses of the prospective construction are estimated at Y.92,880,000. Three hundred thousand tons of ore are to be bought each year from the Tayeh Iron Mine, (China) at Y.2.00 per ton delivered at the mine, estimated approximately at Y.7 per ton delivered at Edamitsu, including the freight and other charges.

With the increase in transportation capacity brought about by the improvement of the Tayeh railway, the iron supply will be increased by 50,000 tons per year. From this source the Japanese Government Iron Foundry will be able to buy 500,000 tons yearly. Although the ore mined at the Tsaining and Yinli mines, which belong to this foundry, are transported to the plant at Edamitsu, the foundry relies for its home ore supply upon the Akutagawa mine of the Mitsui.

Kamaishi Mining Company.

Annual production: 155,000 tons—This mine, which had once been operated by the Government Iron Foundry, has steadily developed, since it was transferred to the possession of Mr. Chobei Tanaka. The Iron Foundry was recently organized into a company with a capital of Y.20,000,000, of which Y.10,-

Original from UNIVERSITY OF CHICAGO

000,000 was already paid up. The output of pig-iron was 35,216 tons and that of steel 22,209 tons in 1916, whereas, now that the construction for expansion of the foundry has been completed, 230 tons of ores are produced per day, the annual output being 120,000 tons.

It is expected that a 120-ton furnace of the Cowber (?) type will be in working order in 1919. When this furnace is completely fitted up, this foundry will be capable of producing 440 tons of pig-iron per day, 155,000 tons annually. The ores contain 60 per cent iron, and the total presumable quantity of the ores in this mine is estimated at 30,000,000 tons. Pig-iron is manufactured here by using charcoal or coke as fuel, and a distinction is made between the products of the two processes, charcoal pig-iron being superior in quality and therefore being used for manufacturing arms for the navy and the army.

Hokkai Iron Company, Ltd.

Production: 90,000 tons—The Hokkai Iron Company, Ltd., became independent in February, 1917. It had formerly been called the "Wanishi Iron Works," at Muroran port and had belonged to the Hokkaido Colliery and Steamship Company.

This company was formed as a joint-stock company, in coöperation with the Mitsui company, with a capital of Y.3,000,000. Previously, the company had only one 50-ton furnace fitted up, but it recently was decided to secure two more 100-ton furnaces. One of them, already completed, is now in operation, and the other was installed in May, 1918. When the construction of these two furnaces has been completed, they will produce 250 tons per day, the annual output being 90,000 tons.

At present the company is using native coke, and iron ores produced in the mines at Tayeh (China), Chosen, and Abuta in Hokkaido.

Sennin Iron Company, Ltd.

Production: 4,000 tons—The Sennin Iron Company, Ltd., is at Iwasaki Village, 12 miles west of Kurosawajiri, Iwate prefecture. The foundry is controlled by a joint stock company under the management of the late Keijiro Amenomiya's heirs. As the pig-iron of this company, smelted with charcoal, contains little sulphur and is very superior in quality, it is supplied to the naval arsenal and the military arsenal at Osaka. The annual production is reported to be 4,000 tons in round figures. The ore from this mine contains from 40 per cent to 50 per cent of iron and the estimated total deposits is reported to be 850,000 tons.

Kuriki Mine Company.

Production: 2,500 tons—The Kuriki Mine Company, with its capital of Y.200,000, is at Kurikisawa Village, Kisen-gori, Iwate-ken, Japan. The daily production is 7 tons, or 2,500 tons a year. The fuel used is charcoal. The manufacture of 100 per cent pig-iron requires 200 per cent to 250 per cent ores and 120 per cent charcoal. Such being the case, the manufacturing capacity will not be increased unless charcoal is amply supplied. The pig-iron produced here is good in quality and is especially used for chilled castings. The mineral quantity of the ores is 50 per cent, and the total deposit is estimated at about 700,000 tons.

Penchihu Mines.

Mr. Suzuki and Mr. Goshima give a long account of the organization and workings of the Penchihu Colliery and iron foundry, which we omit, since the facts are identical with those given in an article on Penchihu which appeared in the January, 1918, number of the "Review."

Anshanchan Iron Works.

Production: 150,000 tons—This plant manufactures both pig-iron and steel. The site of the works is in the vicinity of Changchiapu which is three miles south of Lishan Station on the main line of the Manchurian Railway. This company has bought 1,600,000 tsubo of ground for the site of the foundry, and 2,000,000 tsubo for streets and houses.

The houses, engineering offices, and warehouses which were temporarily built on the ground belonging to the Ryusan Stations to prepare for the building of the foundry were recently completed. Therefore, the Lishan building service department and Ansantien preparation department of this iron works have removed their offices to the above-mentioned buildings. The ground-leveling has been completed, and a few thousand employes are now busy at work constructing the foundry here. The building for furnaces and coke ovens is now under construction. The ovens will be built of fireproof brick.

Most iron mines are in the vicinity of Ansantien Station or to the southeast of the station, and for transportation facilities a light railway will be constructed. The water used by the foundry is to be drawn from the River Chienshan, and if the water runs short, the River Tatsuho will feed the former river through iron tubes stretching 15 miles.

Lishan is situated 196 miles from Dairen port and 59 miles from Yingkow. Access to either of the ports is very easy. There have been many discussions regarding the proper location of an iron foundry. Some have insisted that an iron foundry should be established at an iron mine, and others prefer the vicinity of a coal mine. The Edamitsu Iron Works decided to establish its foundry at its coal mines, while the Anshanchan and Kenjiho (?) Iron Foundries built at their iron mine.

This iron foundry is different in its organization from the Penchihu Colliery and Iron Foundry. The latter is a Sino-Japanese coöperative concern in all its business, from mining to manufacture, while in this foundry the mining work is jointly Chinese and Japanese, but the iron manufacturing is undertaken by the South Manchuria Railway Company alone. The ore mining and the purchase of ground required for mining are under the management of the Japan and China Iron Ore Mining Corporation, the establishment of which was authorized by the competent authorities in the name of Mr. Kanchukwan (?), a Chinese and Mr. Yasuke Kamada, official of the South Manchuria Railway Company. All the ore produced here will be bought by the railway company which will manufacture the iron. This organization is far superior to that of Penchihu.

This iron enterprise is a realization of the mining rights in Manchuria stipulated in the Chino-Japanese treaty of 1915. This is the first fruit of the treaty. When the Anshan mine was discovered in 1909, the mine was so poor that no one dreamt of the ore at this mine being used as iron materials in the near future. The invention of a new separating method and the great European war have emphasized the urgent necessity of self-sufficiency in supply. At the same time the experience and ability in manufacturing iron of General Kakamura, governor general of Kwantung, have been of value in stimulating the iron manufacturing industry.

The Chenhsing Company has borrowed from the South Manchuria Railway Y.140,000 for its capital and is now prospecting for the mine. The actual mining will be commenced in the coming autumn. The head office of this company is in Mukden, and Mr. Wuchunghan and Mr. Kamada have charge of negotiating with other companies and with private interests. The head bureau of mining is at Anshanchan and Mr. Kido, engineer and chief of the geological investigation bureau of the South Manchuria Railway Company, is adviser. Mr. Kido has been lately appointed in charge of general affairs and mining business, thereby filling the vacancy caused by the dismissal of two clerks of the same railway company. The appointment of the officials of this company is not officially announced as yet, but when the iron foundry is completed and when ore is actually in sight, the official appointment will be published.

Chinese Mines.

The total iron deposits in the mines which are now being worked in China are estimated at 700.000,000 tons. The chief deposits are as follows:

Magnetite and hematite at Tayeh in Hupei..	200,000,000 tons
Limonite at Taochunchow in Anhui	50,000,000 tons
Iron ore at Chinlingchen in Shantung........	120,000,000 tons
Hematite at Anshanchan	200,000,000 tons
Magnetite at Penchihu	80,000,000 tons

There are many other unworked mines in China. The mine of Anshanchan consists of eight districts covering the area of 2,640.000 tsubo, and the quantity of minerals existing above the horizon is estimated to be:

West and East of Anshanchan..............	94,000,000 tons
Takushan	37,800,000 tons
Hsiaolingtzu	1,600,000 tons
Tiehshishan	200,000 tons
Kwanmenshan	12,500,000 tons
Yingtaoyuan-Wanchiapa	500,000 tons

At first the quality was thought to be 35 per cent or 40 per cent, but later ores containing from 45 per cent to 60 per cent were discovered at Tosan, Anshanchan and Takushan when the mines were prospected. The annual output of pig-iron at these mines is estimated to be over 1,000,000 tons, so although excavations have been made on a large scale, the life of the mines will continue more than 80 years. The poorer ore will be run through a magnetic separator like that of Penchihu. The invention of this separator has greatly advanced the progress of the iron manufacturing industry in Manchuria.

The coal used at Anshanchan is produced at Penchihu and Kaiping as well as at Fushun, but in course of time Fushun coal only will be used. At first it was thought that the coal of Fushun was unfit for making coke, so it was considered unsuitable for manufacturing iron. However, after repeated studies and investigations into the coal from every colliery, some coal produced here proved to make good coke, and is now in no sense inferior to the coal of Hokkaido. The lime produced at Penchihu and Yentai is transported to Anshanchan, but in time the foundry is going to use lime produced at Liaoyang and its vicinity.

The construction appropriation is Y.30,000,000. Of this Y.8,000.000 will be spent upon the equipment required for pig-iron working and the incidental works for the first period and the construction works which were commenced in March, 1918. Two furnaces are to be fitted up in the course of this year. It is estimated that the annual production of pig-iron will be 150,000 tons. For the purpose of producing in future 1,000,000 tons (manufactured iron, 800,000 tons), 1,600,000 tsubo of ground have been bought for the site of the plant. The remaining Y.22,000,000 is to be spent upon the establishment of a steel foundry, so that machines of several kinds and tools for railway use may be manufactured from 130,000 tons of steel per year to meet demands in Manchuria and the interior of China. Every preparation for making steel is expected to be finished in 1918.

The plan for the first period includes the installation of two furnaces and the daily production of pig-iron amounting to 460 tons. The following items show the detail of the plan:

(1) The initial expense is estimated at Y.8,200,000, of which Y.200,000 is for purchasing the ground. The balance invested will be refunded in 20 years, redeeming Y.241,751 per year.

(2) The floating capital is Y.1,500,000. The inter-

Original from UNIVERSITY OF CHICAGO

est on this sum is estimated at Y.150,000 a year, the rate being 5 per cent per annum.

(3) Profit and loss account: Receipts—Y.5,161,200. Pig-iron, 156,400 tons, Y.51,612,000, the price being Y.33 per ton for delivery at Osaka. As the daily output of pig-iron is estimated at 460 tons, the annual production will total 156,400 tons, supposing the working days of a year to be 240 days.

The chief items of disbursement: The expense of manufacturing 156,400 tons of pig-iron, freight to Osaka, importation tax, expenses of building, sinking fund and interest on floating capital.

The total sum of the above-mentioned expenses is Y.4,426,860.

(4) Net profits—Y.734,340, or about 9 per cent per annum upon a capital of Y.8,200,000.

These estimates were prepared in October, 1916, when the price of iron was low, but today it has gone up and, therefore, the figures cannot be taken as they are. The construction works will also require a larger appropriation than that of the estimate.

Mitsubishi Kenjiho Iron Foundry.

Production: 100,000 tons—A little more than eight miles along the railway from Koshu Station on the Seoul-Wiju line is Kenjiho Station. By going along the Daidoko river about 30 miles one reaches Pengyang. On the lower reaches of this river, 18 miles from Pengyang, there is situated Chinnampo, which is a deep and suitable port for the anchorage of a vessel of 4,000 tons. When a railway was constructed for the transportation of materials to be used for constructing the Seoul-Wiju Railway and an iron foundry was established, this town Kenjiho became widely known. Iron ore and coal are produced everywhere near this port. The foundry avails itself of the river for its transport.

The Mitsubishi Company has bought at Kenjiho ground covering 400,000 tsubo for the building of an iron foundry. The company will be engaged in refining all the ores produced at the mine in Kokaido. It set to work constructing the foundry, May, 1917. A furnace, completed recently, has been in operation since January of this year.

The transportation of ore is dependent upon the Daidoko river, and upon a light railway, seven miles long, newly constructed between the mine-lot and the foundry. Building materials, iron manufacturing materials and manufactured iron will in future be carried by this river. To realize this plan the company has been improving a part of the harbor to facilitate the unloading of building materials and coal.

The Mitsubishi would go a step further and build moorings for ships of 4,000 to 5,000 tons, but the water of the river is so muddy that diving work is very difficult, and in consequence no definite plan of improving the harbor has yet been devised.

According to the investigations made by the Chosen Government it is said that Kokaido is richly endowed with iron mines, and the authorities are now encouraging iron manufacturing enterprises. In fact all the well-known mines in this district are now being worked. Among them there are the Sainei, the Inritsu and the Angaku.

Iron ores produced in the plain at Kenjiho and its neighborhood are hematite turned yellow by oxidation on the surface. Hematite ore can be collected like potatoes by digging into the hills or fields. One cubic tsubo of ground contains one ton of ore, quality of which is 50 per cent, the presumptive total production of ore being 2,000,000 tons. The original plan of the Mitsubishi Company was to instal two 150-ton furnaces and to manufacture 300 tons of pig-iron per day with a capital of Y.10,000,000, but owing to the shortage of steel materials since the outbreak of the present war, and especially of shipbuilding materials, the company has been obliged to commence the manufacturing of steel with an additional capital of Y.10,000,000 to meet the urgent demand of the Mitsubishi Shipbuilding yards. Such being the case, the company, it is said, is extending the manufacture of materials for shipbuilding so as to supply all the dockyards of the company.

As 200,000 tons of ore are required to produce 100,000 tons of pig-iron, the whole deposits of 2,000,000 tons of ore in the mines will be exhausted in 10 years. Therefore the company previously determined to buy ores from other mines in Kokaido to supply its own needs for the first 10 years and to keep its own mines untouched as long as possible. The expenses amounting to Y.20,000,000 for the construction of the iron works is to be repaid in this way; 30 years from now the iron manufactured will be a net profit. It is further planned that ore produced at Chinlengchan, Shantung, will be used by this company and that the ore of the company's own mine in Kankyodo, which is boundless in its supply, will be transported when the Heigen Railway is opened for traffic.

It was first planned to use the Heigen coal as fuel, but investigation proved that this kind of coal is of no use in the manufacture of iron. It is said, therefore, that the Mitsubishi is now contemplating the use of Kaiping and Kontan coal, 700 tons of which will make 400 tons of coke.

As the manufacture of a ton of pig-iron requires two tons of ore, one ton of coke and half ton of lime, it is necessary to have 400 tons of coke to produce 300 tons of pig-iron per day. The coke furnace at this company's works is of the newest type in the East, and is called Otto's Furnace. The patent right of it was obtained in Germany, but it was constructed in America. This furnace wastes no heat and is so constructed as to be capable of producing by-products such as pitch, tar and benzine oil by its own heat.

The construction of a furnace of this kind costs Y.3,000,000.

Okuragumi's Hiroshima Iron Foundry.

Production: 10,000 tons—The foundry is situated in Ogata and Otake villages in Saeki-gori, Hiroshima-ken. It was commenced May 5, 1917. The authorized capital of the foundry is Y.2,350,000. It will manufacture charcoal pig-iron from the ores sent from the mine at Penchihu and will supply material for the special steel required by the naval arsenal at Kure. The annual production is 15,000 tons, the daily output being 20 tons. To produce the quantity desired 500 kwan of charcoal is required, which will be supplied by the western part of the mainland of Japan, Shikoku, Kyushu and Kamchatka.

The above-mentioned foundries have already started their business or have partly completed their workshops and are to be soon operated. We shall now describe some other iron manufacturing concerns which will shortly commence construction works.

Toyo Iron Foundry Company.

Production: 150,000 tons—Having realized the importance of iron manufacturing from the national point of view, a number of the most eminent persons in financial circles are now establishing this iron company. The following facts are said to give an idea of the organization.

1. Y.30,000,000 is to be invested as capital.

2. Two 250-ton furnaces are to be constructed and fitted up for producing 150,000 tons of pig-iron from 300,000 tons of ore each year. Pig-iron is to be made into steel.

3. Iron ore is to be purchased from the iron mine at Taochunghsien, the rights having been obtained by a certain Japanese. A provisional contract for the purchase has already been signed.

4. The foundry is to be established in Kyushu. Eight graduates in engineering from the university have been sent to the Edamitsu Iron Works to study iron manufacturing at first hand.

The Taochung mine is situated near the Yangtze River about 30 miles from Wuhu, Anhui, China. It is called Chanlungshan and stands 350 meters above the bank of the river. This mine was discovered by a Chinese merchant of Wuhu, eight or nine years ago. A company called Yufen, was formed with a capital of Y.30,000 to carry on iron manufacturing, but it was not successful and came to a standstill. Later on the Mitsui Yoko entered into a lease contract with the Chino-Japan Company and has bought all the output of the mine under a 40-year agreement. The mining was begun in September last year, and a few Japanese engineers staying there are engaged in testing the ore. A railway reaching to the river is being planned and will have a gauge of 3 feet 6 inches. It will be 5 miles and 15 chains long.

The ore is to a great extent composed of limonite, the quality being superior to that of Tayeh ore. The total presumptive amount of the ore is believed to be 50,000,000 tons. The annual output, it is calculated, will be 300,000 tons, all of which is to be sold to the Toyo Iron Foundry, according to contract. The ore produced here will command a ready sale to some other companies before the opening of the Toyo Iron Foundry, so the construction of the foundry is steadily in progress. In the event of transporting ore from this mine to Japan, the ore sent to Japan will no doubt contribute a great deal to the iron manufacturing industry. It is very satisfactory to have such a rich mine, for the future of the Tayeh Mine is uncertain.

Chino-Japan Iron Corporation.

Steel Production: 50,000 tons—Mr. Keichiro Yasukawa is the promotor of this corporation. An iron foundry is to be built on the seashore at Kurosaki, Fukuoka-ken, on a tract of 130,000 tsubo, which has yet to be purchased. At the outset, Mr. Yasukawa bought an iron mine in Chosen in order to start a pig-iron industry, but he changed his plans and is now said to have taken an initial step in the purchase of 60,000 tons of Tayeh pig-iron. He is going to manufacture 50,000 tons of steel out of the pig-iron purchased from Tayeh.

Hanyehping Coal and Iron Company.

Production: 400,000 tons—The iron works at Hanyehping is the pioneer in the East, and it owes its establishment to the far-sightedness of Chang Chih-tung. The foundry has an old furnace and a new one. The old one is capable of working up to 100 tons per day, while the new one can turn out 200 tons. The output of iron in 24 hours is 350 tons. Of this output 200 tons are manufactured into steel by means of a converter and the rest is sent to the Edamitsu Iron Works. It is said that two 400-ton furnaces are to be constructed and erected on 750,000 tsubo of land near the Yangtze-kiang. Dr. Oshima and 14 engineers have come to China to make every preparation for the enterprise. The furnaces will be operated toward the end of 1918. They will be able to produce 280,000 tons of pig-iron per year.

Iron imported into Japan from Tayeh totals 60,000 or 70,000 tons each year, including the iron sent to the Edamitsu Iron Works. When the next extension is made 60,000 tons will be sent to the Yasukawo Steel Foundry. The total annual importation will be 120,000 to 130,000 tons.

The ore mined at Tayeh contains 63 per cent of iron, which is hematite. The total deposits in the mine are 200,000,000 tons. The daily production is 1,800 tons. 320,000 tons of the annual output is supplied to Japan and 280,000 tons are sent to Hanyang where the ores are to be made into iron. In three years, 1,500,000 tons will be mined. Then the supply to Japan will be increased by 50,000 tons per year. The maxiumum supply to be made to Japan will be 500,000 tons. This company owes Y.27,840,000 to Japan, and, according to the contract, the iron ore and pig-iron sent to Japan are accepted as payments upon the debt.

In addition to the foundries already listed, both Japanese and Sino-Japanese, there are a number of minor works such as the Kuhara Iron Works, now amalgamated with the Toyo Iron Foundry, the Asano Electric Iron Foundry, the Nippon Steel Company, the Kobe Steel Foundry, the Sumitomo Steel Casting Company, the Nippon Steel Works and the Tokyo Steel Material Company. All are producing steel manufactures of some sort, but have no special relation to the question of the home iron supply. The following table shows the total amount of iron which, it is hoped, will be available to Japan in 1923.

Edamitsu Iron Works	650,000 tons
Kamaishi	155,000 tons
Hokkaido Iron Foundry	90,000 tons
Sennin	4,500 tons
Kurikisawa	2,500 tons
Penchihu	100,000 tons
Anshanchan	150,000 tons
Kenjiho	100,000 tons
Okuragumi, Hiroshima	15,000 tons
Toyo Iron Works	150,000 tons
Yasukawa Iron Foundry	50,000 tons

The increase is great when compared with the tonnage in 1916, which was only 420,000 tons, but when we compare this total amount with the prospective demand in 1923, which it is estimated will be 2,190,000 tons, the supply will still be inadequate and 727,300 tons will have to be found somewhere. In China and Manchuria many mines are left untouched. The foundries which have already been established have much margin for improvement and further extension.

Existing By-Product Coke Oven Enlarged

Youngstown Sheet & Tube Company Increases Capacity Fifty Per Cent—Thaw House Heated by Coke Oven Gas Holds Twenty Cars—Labor Saving Devices Employed.

The Youngstown Sheet & Tube Company, which has had four batteries of coke ovens in operation since August, 1916, decided in 1917 to build a 50 per cent addition to the plant and started work in July, 1917. One of the new batteries was put in operation August 8, and the other September 4, 1918.

These two batteries consist of 51 ovens each, Koppers cross regenerative ovens of 500 cubic feet capacity. The coke from these ovens is sent to the Hubbard blast furnaces of the same company.

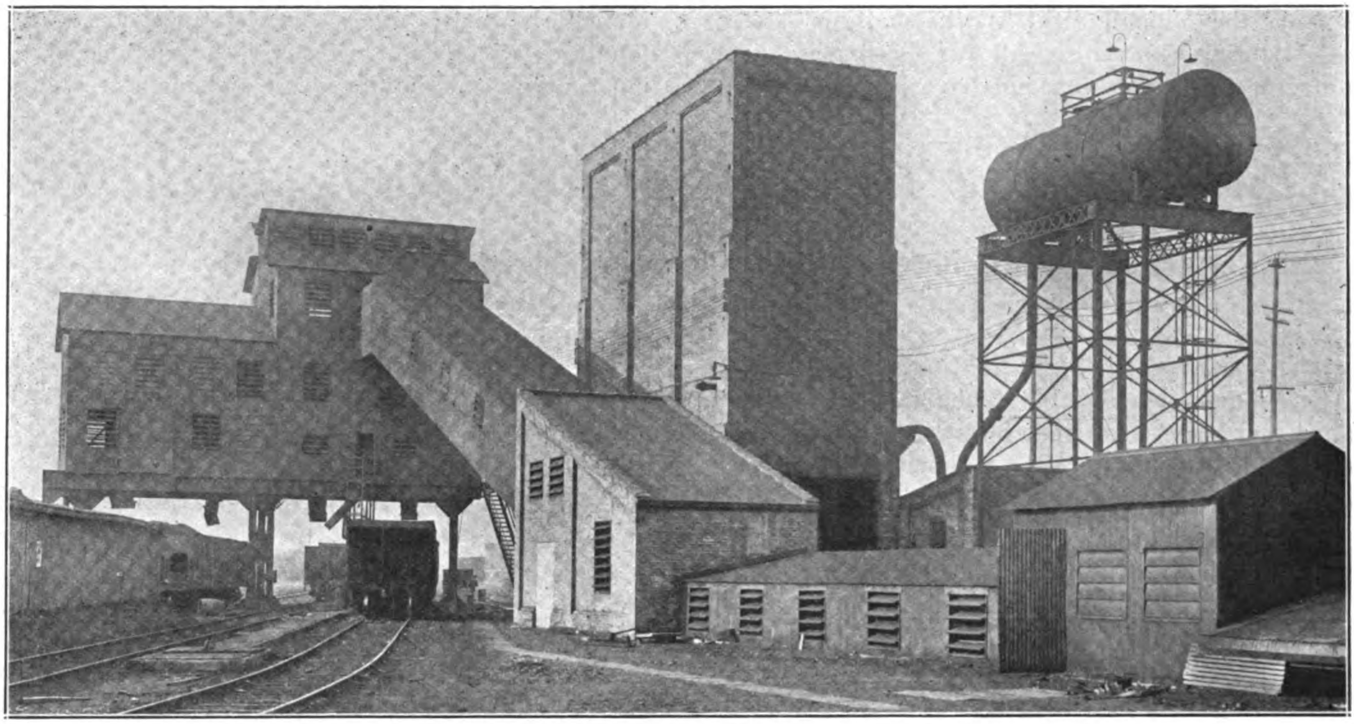
Coal Handling.

The unloading, crushing and mixing equipment for the original four batteries was designed and installed with sufficient capacity for the extension which was forseen at that time. The coal is unloaded by means of a high lift Wellman-Seaver-Morgan car dumper which, was the first one ever installed to serve a coke plant. A 36-inch belt conveyor 350 ft. centers, 500 tons an hour capacity, was installed from the top of the storage bin over No. 1 and 2 batteries to the new storage bin over the new No. 5 and 6 batteries. This bin is 2,000 tons capacity and has a partition so that different mixes of coal can be handled on the two batteries and also so either side of the bin can be conveniently cleaned without interferring with operations. Cleanout manholes are provided near the top of the hopper in each compartment. The drive for the conveyor, feeding this bin is located in the pent house at the top and the conveyor is interlocked electrically with the system behind it.

Owing to the fact that in order to completely fill an oven, it is necessary to pull some coal out of the chuck door when finishing leveling, it was decided to incorporate in the new work plans for handling this spillage which had been developed by the Sheet & Tube Co., for the old batteries. Accordingly a small bin of about three tons capacity was built on the main bin and the coal pulled from the ovens is dropped through a chute attached to the pusher into a hopper on the pusher and from there dropped into a hopper next to the pusher rail whence it is conveyed by a cross conveyor to a vertical bucket elevator discharging into the small bin. The operation is designed so the door extractor man on the pusher can drop the coal from the hopper on the pusher and start the conveyors from the bench level. The small bin is so arranged that the larry man can empty it without getting off his larry car. This is the first installation of its kind on a by-product coke plant.

The two larry cars are equipped with a motor driven swab crane designed by The Youngstown Sheet & Tube Co., and are the same as installed by them on the three larry cars on the old batteries. The object in putting a motor on this apparatus was to make the work so easy that the larry men can attend to this duty without extra help.

Owing to the increased coal consumption due to the extension, it was considered advisable to erect a thaw house for taking care of frozen coal. The engineering department accordingly drew up plans for a thaw house 400 feet long holding 20 cars and spanning the two tracks and house 400 feet long holding 20 cars and spanning the two tracks and the shunter track serving the car dumper. The construction is of reinforced precast concrete columns supporting structural steel trusses and the roof and machinery house. The walls between the columns are built up of the Dennison interlocking hollow tile. The hot air ducts run the length of the building on both sides between the roof and the bottom cord of the roof trusses and the return air duct is between the hot air ducts. Down comers from the hot air ducts convey the heated air up under the cars every five feet on both tracks the entire length of the building. The furnace and machinery houses contain two heating units and fans for delivering the hot air and exhausting the combustion gases. Temperature regulators are provided for automatically controlling the temperature of the air used in the furnaces, also recording pyrometers and thermometers. Coke oven gas is used for heating the air. Automatic control is provided for shutting off all the gas except the pilot lights when the fans are shut down accidentally or intentionally. The fans are each designed to deliver 60,000 cubit feet of air per minute at standard conditions. The air is delivered under the cars at about 225 d. F. and after passing up along the sides and bottoms of the cars, passes into the return air duct through openings in the bottom of this and on to the heating furnaces. The openings in the bottom of the return air duct are adjustable so that an even distribution of hot air throughout the length of the building is obtained by making the proper adjustments in these openings.



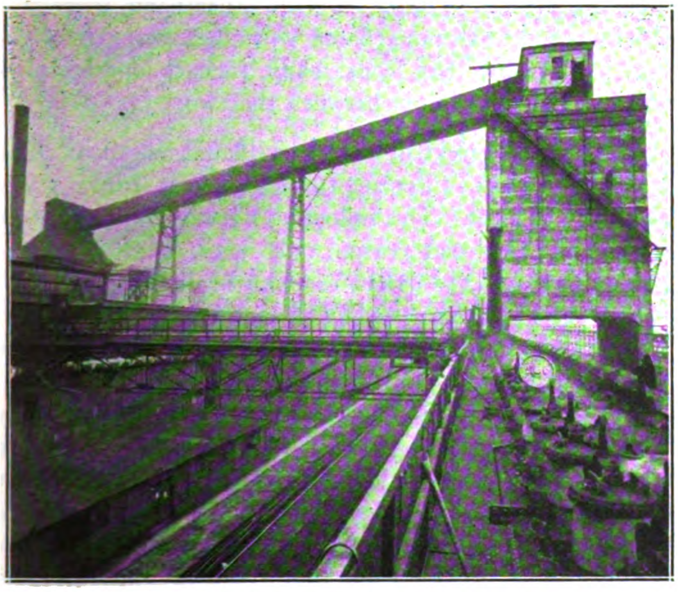
Screening plant.

Coke Handling.

The coke wharf is 125 feet in length and is located at one end of the batteries. Considerable care was given in selecting the location of this wharf so it would not be in front of the ovens, thereby avoiding the troubles especially prevalent in cold weather from steam along the coke side of the batteries. Two General Electric locomotives for hauling the quenching car are provided of the same design as the previous installation.

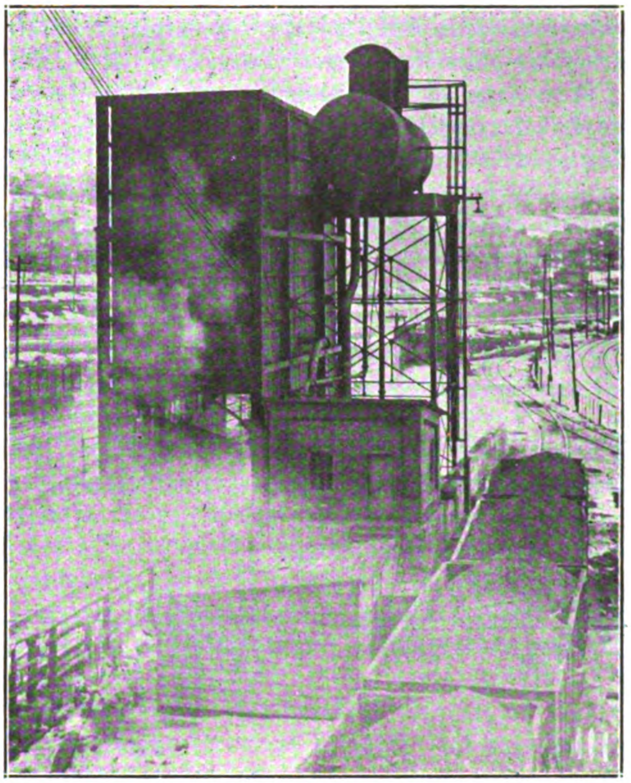
The quencher track is built with 100-pound rails, wooden ties and crushed slag ballast and is supported by a reinforced concrete bed. After the quencher track was laid accurately as to elevation and distance from the ovens, the third rail system was installed at the correct distance and elevation from the quencher track. The same design and care was used in this installation as on the original quencher track which was designed and installed by the company. The continuity of service of the original installation is indicated by the fact that a steam engine has never taken a heat nor has it been necessary to haul out quencher cars or electric locomotives with a steam engine since the plant was started.

From the wharf the coke is conveyed on a 36-inch conveyor 340 feet centers to a new screening station erected for the new batteries. Provision is made by means of a tunnel underneath the quencher track between the wharf and the screening station, so that if in the future the company builds blast furnaces on the coke plant site, a conveyor can be installed to take the coke to a screening station over the blast furnace trestle and deliver into a transfer car running over the blast furnace bins. The coke is screened over bar grizzlies, of which there are two suspended from an overhead carriage. One is a spare and can easily be pulled into position in front of the conveyor when it is desired to remove bars of the other grissly. As a somewhat softer coke is desired in the present operation, special attention was paid both for the purpose of saving breakage of the coke and wear on the chutes, to the installation of coke boxes in the delivery chutes from the bar grizzlies to the railroad cars. By means of a removable coke box at the foot of the screens coke may easily be delivered into cars on either of two tracks running underneath the screening station. The undersize from the bar screens drops on to a 20-inch belt conveyor and is delivered to a revolving screen in which the separation is made into domestic and breeze, these products being delivered into cars on respective tracks underneath the station. Both the bar grizzlies and the revolving screen are the same design as installed in the original screening station. It will be remembered that at this station, coke after being screened is delivered into small receiving bins and from there conveyed over the river on a trestle to the blast furnace bins by means of a 35-ton electrically driven transfer car. All chutes are lined with hard brick laid on edge and the sides of the chutes are lined with chilled cast iron plates. In both the new coal handling and coke handling system, glass windows are practically eliminated and steel louvers substituted. Owing to the fact that the wharf had to be located below the sewer level an automatic electrically operated bilge pump is installed to take care of drainage water. A car pulling winch easily able to handle 12 loaded cars and serving both the coke loading tracks is installed to spot empties and move away the loads.



Concrete Storage Bins.

A brick quenching hood 58 feet high is provided. Steel baffles inside of the hood return any coke which may fly into the air on quenching back into the quencher car. All concrete foundations for the hood which might come in contact with water from the quencher car are carefully veneered with brick. The same type of Dravo-Doyle solenoid operated balanced quenching valve, which the company was the first to adopt for this use, is installed in the new quenching station in the same manner as in the old station.



Quenching coke.

Except for lowering the horizontal flue two inches there is practically no change in the new ovens over the old. In both cases the oven width is 17 and 19½ inches, or an average of 18¼ inches. It was considered desirable, primarily on account of the men in hot weather, to insulate the regenerator and walls. Accordingly the company conducted some exhaustive tests in a specially built furnace, on a variety of insulating materials finally selecting a moderate priced grade of infusorial earth which was put in between

(Continued on Page 117.)

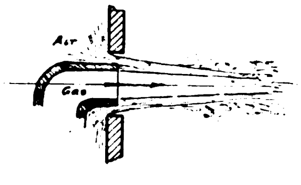
Heating Furnaces and Annealing Furnaces

Speed of Heat Transmission and Required Brick Surface. Volume Required for Burning a Given Quantity of Fuel in Unit Time—Types of Furnaces Compared.

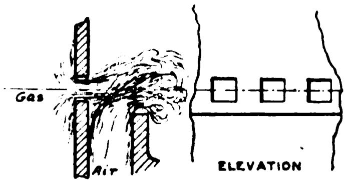
By W. TRINKS.

PART II.

The explanations of the foregoing paragraphs determine how fast heat can be transmitted to the surface of steel being heated, and what brick surface is required in comparison to the steel surface. To illustrate, compute the number of furnaces required to keep a 1,000-ton forging press supplied with 20-inch ingots. Use the rough rule that the output from a 1,000-ton press is 1,000 tons of finished forgings (exclusive of crop ends, etc.) per month. More than this quantity must be heated, on account of overlapping of heats, crop ends, etc. Hence, figure that 1,500 tons must be heated per month of 26 days. Then the heating requirements per hour are $\frac{1,500}{26 \times 24} = 2.4$ tons. About 3 feet of ingot lengths or 1.65 tons are heated at one time, which means that $\frac{2.4}{1.65} = 1.45$ ingots must be heated per hour. From the example on Page 72 of January, 1919, issue of THE BLAST FURNACE AND STEEL PLANT, it is known that such an ingot can be heated in 7 hours. We need 7 × 1.45 = 10 furnace doors to keep the press busy without delay, and it will be better to allow 11 or 12 doors on account of repairs to furnace and doors.



Fg. 8.



Fg. 9.

With almost any type of furnace, the interior brick surface is sufficient to give the necessary surface for heat absorption by convection, and for heat emission by radiation, unless the flame travel is exceedingly faulty.

The cost of a furnace is very nearly proportional to its cubical contents. It is, for that reason, desirable to make furnaces as small as conditions will permit. Unfortunately, the term "as small as conditions will permit" is very indefinite, and much research work must be done before all difficulties connected with that statement are cleared away. While the main discussion of these difficulties will be left to the critical description of different designs of furnaces, it may be mentioned here that the problem consists in determining the space of volume required for burning a given quantity of fuel in unit time. To illustrate the point, compare Figs. 8 and 9. The former illustrates a large gas burner having one solid chunky gas stream, whereas, the latter illustrates a burner arrangement in which gas and air are blown into each other at right angles in many small streams. It is evident that in Fig. 8 the flame will be very long and its outer layer highly oxidizing, scaling and burning the material to be heated, while in Fig. 9 the flame will be quite short, with very little excess oxygen at the place where the gases strike the steel. On the other hand, there will not be a long luminous flame with the arrangement of Fig. 9, a result that leads many furnace operators to prefer a happy medium between the two.

Plainly, the great difference of flame length of Figs. 8 and 9 require different furnace spaces for a given liberation of heat. The following figures giving furnace volume are, for that reason, only very rough averages. With oil or gas fire 3 Btu/sec. can be liberated in each cubic foot of furnace space. If powdered coal is used, a difference arises between those furnaces in which the coal is burned over and near the material to be heated, and those furnaces in which a separate combustion chamber is used for the purpose of depositing the ash before it reaches the heating chamber proper. (In the former case 3 Btu/sec. can be developed per cubic foot of furnace.) Under these circumstances only 1½ Btu/sec. are developed for each cubic foot of furnace and combustion space. These figures give total volume of the empty furnace. If a separate combustion chamber is used, the figures may be doubled. And if the adjustment of combustion is perfect, they may be trebled, or even quadrupled. More will be said about that feature under the heading of critical description of different types of furnaces.

In studying heat transmission in furnaces we run across conditions which are directly opposite to those we find in the study of heat transmission in boilers, condensers, inter-coolers, and great difficulty in getting the heat into the metal, while the heat passes through the metal with comparatively small resistance and practically no temperature drop. In furnace engineering, on the other hand, many instances are found in which heat transmission through the surface of the material to be heated is very rapid compared to the heat transmission from that surface to the interior of the material. The surface temperature, in these instances, greatly exceeds the temperature of the interior, the outer layers expand more rapidly than the inner ones, and troublesome circumferential cracks develop in the interior of the material. The theory of temperature distribution in steel which is being heated is complicated by the great absorption of heat within the critical temperature range (transformation point), see Fig. 3. The effect of the latent heat of transformation is well illustrated by Fig. 10, which shows the results of a test made by E. F. Law (see paper "Effect of Mass on Heat Treatment," read before Iron and Steel Institute, May 3, 1918). The curve represents temperatures plotted against time. When the critical temperature has been reached, the temperature of the center lags very considerably behind the temperature of the surface.

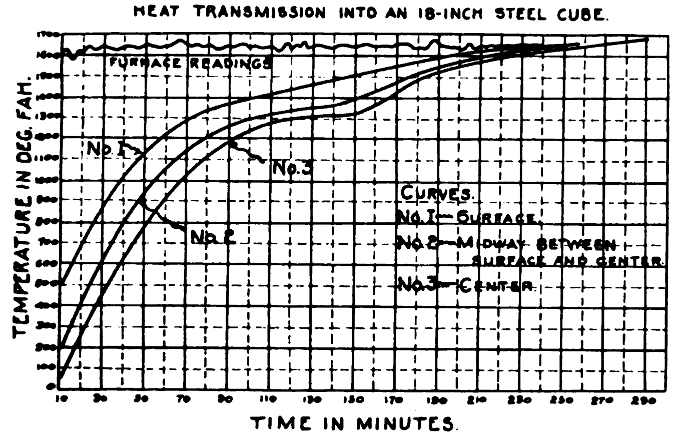


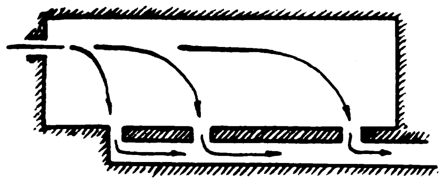
Fig. 10.

The coefficients of conductivity for steel are known. In consequence, the temperature distribution in an ingot such as represented by Fig. 10 can be calculated as a function of time. The calculation is not only very tedious, but it is practically fruitless, because we do not know what extensions steel can stand without rupture at different temperatures, and when pulled both radially and tangentially. Many tests will have to be made to furnish the necessary information for rational calculation of the minimum heating time for a given ingot. In the meantime, we must be guided by experience. If we shorten the heating time of a given size of sheet more and more, we will come to a point where the forgings will have internal cracks. We then know that the danger limit has been passed. Experience shows that a heating time of 18 minutes per inch of diameter is safe for plain carbon steel, while a heating time of 40 minutes per inch of diameter is safe for alloy steel. Another rule of experience states that "heat will penetrate steel $\frac{1}{8}$ inch in 5 minutes," which means that it will penetrate 1 inch in 40 minutes, or will heat a 2-inch diameter steel bar in that time. This rule, in other words, requires a heating time of 20" minutes per inch diameter. Still another rule states that, for alloy steel, 2 minutes should be allowed for every square inch of cross-sectional area. This rule may be written in this form: Heating time in hours equals $(d''/6.2)^2$. The great difference in the form of the rules indicates the necessity for further research.

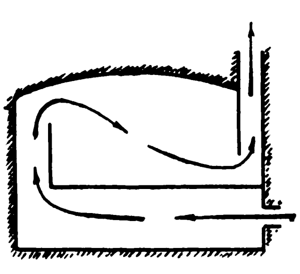
For the capacity of annealing furnaces equation 1 may likewise be used. From Fig. 4 it will be noted that in annealing furnaces, with steel temperatures of 1,600 to 1,800 degrees F., the heat transmission coefficients are much lower than they are in heating furnaces. This drop in the value of the coefficient is due to the circumstance that (with a few exceptions) no high temperature flame can be allowed in an annealing furnace. And where direct flame is allowed in an annealing furnace, it is long and smoky with a low temperature, just high enough to keep the flame from being extinguished. Flame temperatures for quick combustion exceed 3,000 degrees F. The presence of a high temperature flame in the annealing chamber would make temperature regulation impossible. For that reason the fuel is usually burned in separate combustion chambers. Part of the heat is transmitted to the annealing chamber by radiation from the walls of the combustion chamber, and part of it by the flue gases during their sweep from the combustion chamber through the annealing chamber.

The types of furnaces which are in common use for this work are diagrammatically indicated in Figs. 11, 12, 13 and 14.

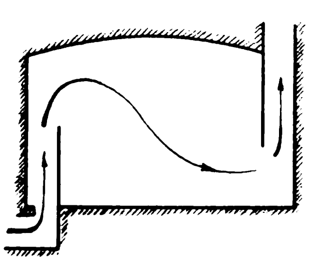
The statement made above that "equation 1 can be used for annealing furnaces" is correct, but in its application considerable difficulty arises, if many pieces are annealed in one furnace simultaneously. Take for instance, the arrangement of material shown in Fig. 15, which latter is a reproduction of Fig. 14 with addition of the material to be annealed. A glance at the illustration teaches that heat transmission to the pieces (1) in the upper row is vastly different from heat transmission to those in the bottom row and that pieces (2) are in a paricularly unfavorable location. Pieces (1) receive not only the hottest flame, but also the radiation from the perforated arch which is very hot, while pieces (2) receive practically no radiation from the perforated arch



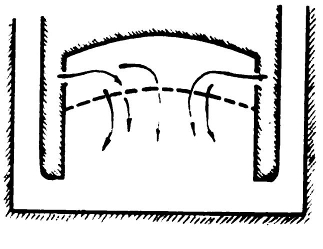
DIRECT FIRED
Fig. 11.



UNDERFIRED
Fig. 12.



SIDEFIRED
Fig. 13.



OVERFIRED
Fig. 14.

and have scarcely any flame passing over them. If the pieces are packed closely, those marked (1) will be overheated if pieces (2) are brought to the right temperature, or else those marked (2) will not be annealed if pieces (1) are brought to the right temperature. These facts are mentioned in the present place not as any criticism of the overfired annealing furnace, but as an illustration of the difficulty encountered in figuring annealing capacities. For, while in practice, packing as close as that shown in Fig. 15 is not used, great differences in heating time must necessarily exist between pieces (1) and pieces (2) even with more open spacing, and unfortunately, the time required to properly anneal piece (2) determines the time for the whole charge.

To make matters worse, heat is lost through the bottome of the furnace in Fig. 15. The temperature rise of pieces (2) then is the resultant of heat addition from above and heat abstraction from below. There will be no more temperature rise when heat addition and heat abstraction are equal. And temperature rise will be very, very slow, when the two are almost equal.

It is no wonder, then, that the use of equation 1 for annealing furnaces is beset with difficulties. For a given construction of furnace (including effectiveness of heat insulation of bottom), coefficients for equation 1 can be derived which will, of course, vary with the method of loading the furnace.

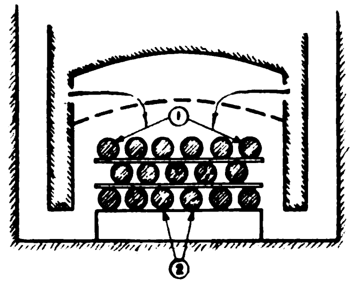


Fig. 15.

In the absence of such specific information, a rough approximation can be effected by judicious selection of values of the area coefficients k_a see Page 71 of the January issue. Since, in the type of furnace under consideration, so much of the heat is transmitted to the steel by radiation, "that fraction of the heated periphery, which the worst located piece of steel can see" plays an important part. The smaller the fraction of the hot walls which it can see, the slower will be the heating, and the more the piece under consideration will have to depend upon secondary radiation from the more favorably located pieces. In consideration of the many influences at work, any simple expression for the coefficient k_a must necessarily neglect several of them and must necessarily be accepted with caution.

With these qualifications, the following coefficient for k_a is recommended. Let $\frac{1}{p}$ be the ratio of that fraction of the heated periphery of the furnace which the worst located piece can see, to that faction which it could see, if it were alone in the furnace, then $k'_a = k_a \sqrt{\frac{1}{p}}$ with the understanding that no higher value be used for p than 12. The use of this coefficient will be understood from an example.

For the latter we select a side-fired furnace, in which five shafts are being heated for annealing purposes, see Fig. 16. Let the shafts be 10 inches in diameter, and let us consider a foot of length at right angles to the plane of the illustration. Then heat-absorbing surface per shaft equals $\frac{\pi \times 10}{12} = 2.62$ square feet. The obstruction factor is about ½, and if the center bottom piece were alone in the furnace, its area factor would be $k_a = .8$ (which means that 80 per cent of its surface would be effective as heat absorbing surface). Hence $k'_a = .8 \sqrt{½}$. Let it be required that the steel be heated to 1,600 degrees, F., and let the wall temperature be 1,700; then average temperature difference equals $100 + 1/3 \times 1500 = 600$ degrees F. Heat to be added per foot of length equals $\frac{\pi}{4} 10^2 \times 12 \times .29 \times 1500 \times .17 = 69600$ Btu. Heat transmission coefficient, from curve (1) of Fig. 4 on Page 71, of January issue, equals 16; hence $69600 = 2.62 \times 16 \times .56 \times 600 \times$ hours, and time required for heating $= \frac{69600}{2.62 \times 16 \times .56 \times 600} = 5$ hours, provided that the furnace is hot when pieces are charged. If the furnace is cold, the mass of the brick must also be heated, and the time is much greater. If additional shafts had been placed in the spaces A, then the shaft B would receive practically no direct radiation from the hot walls. In that case, the maximum obstruction factor $\frac{1}{12}$ may be used, or else the outer half periphery of the shafts C, A, C, A, etc., may be considered the only heat-absorbing surface for the shafts C, A, and also for shaft B. The latter method would suppose that heat is transmitted from the outer circle of shafts A and C to the separate shaft B by conduction, when, as a matter of fact, B must be heated by radiation only. This radiation must wait until the inner surfaces of the shafts C and A have been heated sufficiently to radiate. In consequence, the latter method of figuring the heating time results in show-

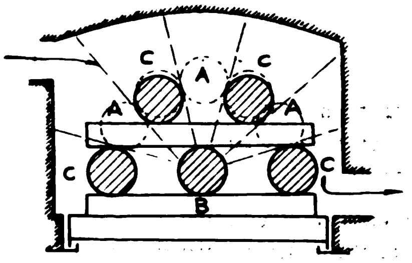


Fig. 16.

ing too short a period. Correct calculation is both tedious and difficult, and will be postponed to later chapters.

Unfortunately for the simplicity of calculations, but very necessarily for practical reasons, material to be annealed is practically never charged into hot furnaces, because every annealing furnace cools down during the process of emptying and refilling, while many furnaces are allowed to cool down with the charge in them.

The immediate object of the present discussion is to find the capacity of annealing furnaces. But capacity may be expressed by the ratio: $\frac{\text{weight of charge per cycle}}{\text{time per cycle}}$ and "time per cycle" equals heating time + soaking time + cooling time + refilling time. Now, it is evident that the designer of the furnace has no control over three of the four terms of the sum. The metallurgist of the purchasing firm usually determines how long the material shall "soak" after it has been brought up to temperature. He also determines the rate of cooling, and the temperature to which the material is to be cooled. The refilling time depends upon the facilities for handling the material, and upon the degree of exertion of the workmen. And the circumstance that the temperature to which the material is to be cooled in the furnace is variable, and subject to the dictation of the furnace operator makes even the heating time uncertain, as far as the builder of the furnace is concerned. It may be argued that furnace engineers can and should obtain data from existing furnaces so that they can assist intending purchasers in the selection of the proper size of furnaces; but such argument is weak, because metallurgists differ in their opinions on what constitutes the best heat treatment for materials. And the difference of opinion is by no means negligible. Likewise, the differences in the method of handling the material are quite great. Whereas, in some instances the whole annealing cycle is carried on in one and the same heating chamber, the heated material in other instances is pulled out of the annealing furnace into a cooling furnace, where it is allowed to cool slowly, while another charge is being heated in the annealing furnace. Such an arrangement vastly increases the annealing capacity of the plant, not only because the time of cooling is eliminated from the annealing furnace cycle, but also because the annealing furnace proper is not cooled down, so that the time of heating the mass of the brick is reduced.

In spite of all these variables, the beginner may wish to have some figures to tie to; he will want something which will act as a rough guide. For this purpose only, the following data is given: With one row, or one layer of pieces in the furnace the time per inch diameter or thickness is 25 minutes for heating, 20 minutes up to 30 minutes, depending upon the metallurgical effect desired, for soaking, and 25 minutes for cooling. If there are two layers or rows in the furnace, the time is doubled, unless the pieces are spaced so far apart that they practically amount to one layer only. This would make the time of an annealing cycle for 40-inch rolls, with two layers in the furnace $2 \times \frac{40}{60} \times (25 + 20 + 25) = 94$ hours, exclusive of time for filling and emptying. In comparing these figures with their own results, many operators of annealing furnaces will judge that the time here given is too short because they cannot do the work in so short a time with their own furnaces. But whenever the time given by the above data is exceeded, we may be sure that the furnace is not designed for quick and uniform heating and has not a maximum possible capacity.

Any investigation of the capacity of heating furnaces and of annealing furnaces beyond the crude methods given in these two installments leads to mathematical difficulties which make cold chills run down the spine of the average engineer. An outline of such investigation will, however, be given in some of the very last chapters of this series.

Steel Plant Industrial Relations Studied

Plan Developed and in Use at the Youngstown Sheet & Tube Company, Whereby Elected Employe Representatives Meet and Discuss Problems of Managament and Welfare.

The Youngstown Sheet & Tube Company, of Youngstown, Ohio, and its employes, established the following plan of representation of employes in order to provide effective communication and means of contact between the management and the men on matters pertaining to industrial relations, and to insure justice, maintain tranquility, and promote the common welfare.

Representation.

1. Employes are entitled to elect from among their own number duly authorized representatives with power, as hereinafter set forth, to act on their behalf on matters of special interest to employes and of general concern to the company.

2. Company officials, salaried employes, and persons having the power to hire or discharge shall not be eligible to act as representatives, or be qualified to vote. Representation of the interests of such employes shall be provided for otherwise by the company.

3. For the purpose of fixing units of representa-

tion, based upon the natural subdivisions of the company's works and made with regard to logical groupings and location, the following divisions are hereby created:

Coke works.
East Youngstown Furnaces.
Hubbard furnaces.
Open hearth.
Converting mill.
Blooming and continuous.
Skelp mills.
Puddle mill.
Plate mill.
Sheet mill.
Tube mill welding department.
Tube mill finishing department.
Rod, wire and conduit.
Merchant mills.
Transportation.
General labor and construction.
General shops, general mechanics and general electrics.

4. Adjustments in units of representation may be made by the joint general committee, hereinafter mentioned.

5. There shall be one representative for each 300 employes; provided, however, that the joint general committee may from time to time make such adjustments as it may deem advisable to meet special cases; and provided, further, that any division having less than 300 employes shall be entitled to one representative, and any division having between 300 and 600 employes shall be entitled to two representatives. Where the number of employes in any division exceeds 600, or any multiple of 300 by 150 or more, the employes of such division shall be entitled to elect an additional representative.

6. The above representation shall be based on the average number of employes of each division as shown on the force reports of the company for the three months of September, October and November immediately preceding the election. For the purpose of determining the proper representation of any division, the general committee shall have access to the proper force reports.

Terms of Representatives.

1. Representatives shall be elected for a term of one year, and until their successors are elected and qualified. Representatives shall be eligible for reelection.

2. A representative may be recalled on petition signed by two-thirds of the voters in his division and approved by the general committee.

3. Upon severance of his relations with the company, or upon his appointment to such a petition as would bring him within the meeting of section 2 of article 1, a representative shall immediately and automatically cease to hold office. A like disqualification shall obtain in the case of any declarant representative upon his failure to obtain citizenship papers in accordance with statutory requirements.

4. Vacancies in the office of representative may be filled in the discretion of the committee on rules by special elections, conducted in the same manner as the general elections.

Qualifications of Representatives and Voters.

1. Subject to the limitations of Section 2 of Article 1, any employe whose name appears upon the company's payrolls for a period of one year in the aggregate in the eighteen (18) months immediately preceding the nominations, who is twenty-one (21) years of age, or over, and who is an American citizen, or a declarant for American citizenship, shall be qualified for nomination and election as a representative.

2. Subject to the limitations of Section 2 of Article 1, all employes whose names appear on the company's payrolls for a period of at least sixty (60) days prior to the date of nominations and who are eighteen (18) years of age or over, shall be entitled to vote.

3. Before entering upon his duties, each representative shall take and subscribe to the following oath of office, which shall be administered by any officer empowered to administer oaths under laws of the state of Ohio.

I solemnly swear (or affirm) that I will faithfully support the constitution and laws of the United States and of the State of Ohio, and the plan of representation of the Youngstown Sheet & Tube Company and employes; and that I will, to the best of my ability, faithfully and conscientiously discharge the duties incumbent on me as a representative under such plan.

First Nominations and Elections.

1. The delegates already elected shall select such committees of the workmen as they may deem advisable who shall conduct the first nominations and elections in the manner prescribed herein. Delegates shall be eligible to act on such committees.

2. At the first election, the full number of representatives shall be elected and qualified to serve until January 1, 1920, and until their successors are elected and qualified.

Nominations and Elections After the First Nominations and Elections.

1. Nominations and elections shall be held annually, in the month of December.

2. Nominations shall be held on the first Tuesday, and election on the following Friday of the month named. In event of either of these days being a holiday, the day immediately following shall be substituted.

3. The total number of representatives shall be chosen at each annual election.

4. The nominations and elections after the first

nominations and elections shall be conducted by the employes themselves, in accordance with rules and regulations prescribed by the committee on rules, and with such assistance only from the management as may be required by the committee on rules.

5. There shall be three persons nominated for every person to be elected.

6. Nominations and elections shall be by secret ballot, and so conducted as to avoid undue influence, or interference with voters in any manner whatsoever, and to prevent any fraud in the count or otherwise.

7. On the day of nominations, each duly qualified voter shall be furnished with a ballot indicating the number of persons for whom he is entitled to vote, on which he shall write the names of the persons in his division whom he desires to nominate as representatives. Where within the one division there are two or more persons of the same name, the voter's preference shall be indicated by adding the check number to the name.

8. A voter may place in nomination twice the number of representatives to which his division is entitled.

9. If on any ballot the same name is placed in nomination more than once, it shall be counted but once.

10. Should the number of persons nominated on any ballot exceed the permissible number, as provided in Section 8 of Article V, which number shall be stated on the ballot, the ballot shall be void.

11. Persons, to the number of three times as many representatives as the division is entitled to, receiving the highest number of nomination votes shall be regarded as duly nominated candidates for election as representatives.

12. On the day of elections, each duly qualified voter shall be furnished by the committee on rules with a ballot, on which the names of the candidates shall be printed in alphabetical order. The voter shall indicate his preference by placing a cross (X) opposite the names of the candidates of his choice.

13. Candidates, to the number of representatives to which a division is entitled, may be voted for, and this number shall be stated on the ballot. If this number is exceeded, the ballot shall be void.

14. Each voter shall deposit his own ballot in a box provided for that purpose by the committee on rules, and the ballots shall be counted under the direction and supervision of said committee. The candidates receiving the highest number of votes shall be declared elected.

15. In the event of tie, seniority in the company's employ immediately preceding the date of election shall determine the choice.

16. The election ballots shall be counted under the direction of the committee on rules, and lists in triplicate, showing the number of votes cast for each person, shall be prepared by the committee on rules and signed by each member thereof; one of which lists shall be posted in a conspicuous place in the division; one forwarded to the management's representative, as evidence that the persons elected are duly accredited; and one retained by the committee. The persons shown by such certified lists to have been elected, as provided herein, shall be the representatives of the division for the ensuing year and until their successors are elected and qualified.

17. The committee on rules shall seal and hold in safe custody for a period of 10 days the ballot boxes containing both the nomination and election ballots. In case of an appeal, signed by not less than two-thirds of the voters of any division within this 10-day period, questioning the validity of the count, the committee on rules shall deliver the sealed ballot boxes to the general committee. The general committee shall count and certify by signed lists, in the same manner as provided in Section 16, Article V, and there shall be no further appeal from its decision. If in the judgment of the general committee any irregularities appearing are such as to demand a new election, they are authorized to call such election.

18. The committee on rules may make such provisions as they deem necessary for assisting any voter, who may so request, in properly making his ballot.

The Management's Representative.

The company shall appoint a management's representative to facilitate close relationships between the management and the employes' representatives. The management's representative shall keep the management in touch with the representatives, their officers and committees. He shall respond promptly to any request from representatives, and shall interview all of the representatives from time to time, but not less frequently than once every month, with reference to matters of concern to employes, and report the result of such interviews to the management.

Committees.

1. On the first Monday of January immediately following their election, the representatives shall meet and elect from among their own number, a chairman, a secretary, a general committee, and a committee on rules, and may then, or from time to time thereafter, appoint such other committees as they may deem necessary to consider any of the following subjects

Wages, employment and working conditions, housing, domestic economics, and living conditions, safety and prevention of accidents, sanitation and health, transportation (employes), works practice, methods, and economics, education and publication, recreation, athletics, and entertainment, continuous work and reconstruction problems.

2. The committee on rules shall have jurisdiction to consider matters relating to rules, procedure, and elections.

3. The several committees shall have jurisdiction

Digitized by Google Original from UNIVERSITY OF CHICAGO

to consider the subjects indicated by their respective titles and such other matters and things as may from time to time be referred to them by the general committee.

4. The general committee shall have jurisdiction to consider all matters not falling within the scope of any other committee constituted and acting hereunder, and shall when jointly composed, act as a committee on appeals.

5. Each committee shall be composed of five members, two of whom in the case of the general committee shall be the chairman and secretary of the representatives. Each of the other committees shall appoint its own chairman and secretary. Except upon approval of the joint general committee, no representative shall serve on more than one committee.

6. Vacancies on committees shall be filled by the general committee at any regular meeting.

7. There shall be joint committees, which shall consist of the committees of the employes' representatives, as herein provided, and representatives who shall be named by the management, whose number may equal, but shall not exceed, the number of the employes' representatives.

8. The joint committees shall select their own officers, and arrange their own procedure, a subject to appeal in case of controversy to the joint committee on rules.

9. Whenever the work "committee" is used throughout this instrument, it shall mean the separate committee of employes' representatives. Whenever the words "joint committee" are used, they shall mean the joint committee as provided for in Section 7 hereof.

10. By unanimous consent of the joint general committee, the membership of any committee or joint committee may be reduced or increased, or any or more committees or joint committees may be combined, or any new or special committee or joint committee may be formed.

Committee Meetings.

1. Regular meetings of committees shall be held once a month.

2. On alternate months, the committees shall meet as joint committees.

3. Committees shall meet between the hours of 3 and 5 in the afternoon, unless otherwise arranged for on joint approval of the chairman of the employes' representatives and the management's representative.

4. Special meetings of committees and of joint committees may be held as occasion may require, on approval of the chairman of the employes' representatives and the management's representative.

5. For time necessarily occupied in actual attendance at regular meetings, or at special meetings of conference jointly approved, representatives shall receive from the company, payment commensurate with their average earnings.

6. Representatives shall have the right to appear before and be heard by a committee on any matter of concern to the employes of the division they represent.

7. A committee when concerned with matters which especially apply to any particular division, or class of employes, shall have the right to invite into conference either or both the representatives of the employes and of the management, likely to be specially interested in such matters.

8. Any matter may be referred by the management through the management's representative to any committee, or joint committee, for consideration and report; and likewise, any matter may be presented by a committee, or joint committe, to the management, through the management's representative, for consideration and report.

9. The joint committee on rules shall arrange a suitable place for meetings of the representatives, and of the several committees and joint committees.

Annual Conference.

An annual conference between all of the employes' representatives and representatives of the management shall be held at a time and place determined by the joint committee on rules, who shall be in charge of the procedure at such conference.

Principles and Policies Governing Relations Between Management and Employes.

1. The representation of employes herein provided shall in no way abridge or conflict with the right of employes to belong to labor unions.

2. For offences other than such as are publicly posted, employes shall not be discharged without first having been notified that a repetition of the offense will be cause for dismissal. A copy of this notification shall, at the time of its being given to an employe, be sent also to the management's representative, and be retained by him for purposes of future reference.

3. The management of the works and the direction of the working forces, including the right to hire, suspend, discharge, or transfer, and the right to relieve employes from duty because of lack of work, or for other legitimate reason, is vested exclusively in the management; and, except as expressly restricted herein, these rights shall not be abridged by anything contained herein.

1. Violation of any law.

Special attention is called to the following:

a. Carrying concealed weapons; fighting or attempting bodily injury to another employe; drunkenness; bootlegging; habitual use of drugs; conduct which violates the common decency or morality of the community.

b. Offering or receiving money or other valuable

(Continued on page 122.)

Review of Technical Literature for 1918

Technical Magazine Articles, Engineering Society Discussions and the More Important Current Contributions to the Literature of the Iron and Steel Industry of This and Foreign Countries.

Abbreviation.	Name of Publication.	Address.
American Drop Forge Association.	American Drop Forge Association.	Detroit, Mich.
A. D. F.	American Drop Forger.	National Iron and Steel Publishing Company, Pittsburgh, Pa.
American Foundrymen's Association.	American Foundrymen's Association.	Cleveland, Ohio.
American Machinist.	American Machinist.	10th Ave. and 36th St., New York, N. Y.
Arch Sci. Phys. Nat.	Archives des Sciences Physiques et Naturelles.	Genf, Switzerland.
Assoc. of Ir. and St. Elec. Engrs.	Association of Iron and Steel Electrical Engineers.	J. F. Kelly, 512 Empire Bldg., Pittsburgh.
B. F. and S. P.	Blast Furnace and Steel Plant.	National Iron and Steel Publishing Company, Pittsburgh, Pa.
Bul. A. I. M. E.	Bulletin American Institute of Mining Engineers.	29 W. 39th St., New York, N. Y.
Can. Chem. Jnl.	Canadian Chemical Journal.	540-541 Confederation Life Building, Toronto.
Ceram. Soc.	The Ceramic Society.	Central School of Science and Technology, Stoke-on-Trent, London.
Chem. and Met. Eng'ng.	Chemical and Metallurgical Engineering.	10th Ave. at 36th St., New York, N. Y.
Colliery Guardian.	Colliery Guardian.	30 and 31 Furnival St., Holborn, London, E. C. 4.
Comptes Rendus.	Comptes Rendus.	Paris, France.
Elec. Jnl.	Electric Journal.	1204 Keenan Bldg., Pittsburgh, Pa.
Elec. Wld.	Electrical World.	239 W. 39th St., New York, N. Y.
Eng'ng.	Engineering.	35 and 36 Bedford St., Strand, London, W. C. 2.
Foundry.	Foundry.	Penton Publishing Co., Cleveland, Ohio.
Gas Jnl.	Gas Journal.	11 Bolt Court, Fleet St., London.
I. & C. T. R.	Iron and Coal Trades Review.	165 Strand, London, W. C. 2.
Iron Age.	Iron Age.	239 W. 39th St., New York, N. Y.
I. T. R.	Iron Trade Review.	90 West St., New York, N. Y.
Jnl. Franklin Inst.	Journal of the Franklin Institute.	Philadelphia, Pa.
Jnl. Ind. and Eng. Chem.	Jorunal of Industrial and Engineering Chemistry.	Easton, Pa.
Jnl. Ir. and St. Inst.	Journal of the Iron and Steel Institute.	28 Victoria St., London, S. W. 1.
Jnl. Soc. Chem. Ind.	Journal of the Society of Chemical Industry.	Central House, Finsbury Sq., London.
Machinery.	Machinery.	140 Lafayette St., New York, N. Y.
Met. and Chem. Eng'ng.	Metallurgical and Chemical Engineering.	10th Ave. at 36th St., New York, N. Y.
Mining Sci. Press.	Mining and Scientific Press.	233 Broadway, N. Y.
Power.	Power.	10th Ave. at 36th St., New York, N. Y.
Rev. Métallurgie.	Revue de Métallurgie.	7 Rue de Madrid, Paris, France.
Stahl und Eisen.	Stahl und Eisen.	Dusseldorf, Germany.
Trans. A. I. M. E.	Transactions of the American Institute of Mining Engineers.	29 W. 39th St., New York, N. Y.
West of Scotland Ir. and St. Inst.	West of Scotland Iron and Steel Institute.	93 Hope St., Glasgow, Scotland.

Blast Furnace.

Blast Furnace Slag Viscosity Tables. By A. L. Feild and P. H. Royster. In B. F. & S. P. March, 1918. Pp. 117-120. (American Institute Mining Engineers.)

Blast Furnace Slag Viscosity Tables. In B. F. & S. P. May, 1918. Pp. 218-219.

The Blast Furnace and Its Resources. By W. J. Foster. In I. & C. T. R. May 17, 1918. P. 554. Read before Birmingham Metallurgical Society, May 9, 1918.

Blast Furnace Bears. By J. E. Stead. In Jnl. I. & S. Inst. Vol. 93, Pp. 157-199.

Blast Furnace Hoist Installations. By David L. Lindquist. In I. T. R., June 20, 1918. Pp. 1543-1549.

Blast Furnace Pre-heater. In I. T. R. Feb. 28, 1918. Pp. 541-542.

Blast Furnace Gas and Recovery of Potash. By A. Lennox Leigh. In I. & C. T. R. Jan. 18, 1918. Pp. 57-58. Read before Cleveland Institution of Engineers, Tuesday, Jan. 15, 1918.

Cleaning Blast Furnace Gas for Boilers and Stoves. By A. L. Leigh. In I. & C. T. R. 1918. Vol. 96. Pp. 57-58.

Coke Factors Affecting Furnace Operation. By G. D. Cochrane. In B. F. & S. P. December, 1918. Pp. 502-504. (British Iron and Steel Institute.)

Coke as Blast Furnace Fuel. By G. W. Hewson. In Jnl. Soc. Chem. Ind. Feb. 28, 1918. Pp. 601-631.

Combined Motor and Turbine Driven Blast Furnace Blower. In I. & C. T. R. Nov. 8, 1918. P. 523.

Blast Furnace Slag Association Formed. In B. F. & S. P. Feb. 1918. P. 85.

Copper Tuyeres for Blast Furnaces. By A. K. Reese. In B. F. & S. P. Aug., 1918. Pp. 329-330. (British Iron and Steel Institute.)

Commercial Aspects of the Recovery of Potash in the Manufacture of Pig Iron. By Kenneth M. Chance. In I. & C. T. R. Jan. 18, 1918. Pp. 58-59. (Read before Cleveland Institution of Engineers, Tuesday, Jan. 15, 1918.)

Developments of the Electric Skip Hoist. By David L. Lindquist. In B. F. & S. P. June, 1918. Pp. 264-267. (Association Iron & Steel Elec. Engineers.)

Development in Burning Coke Breeze. By John Van Brunt. In B. F. & S. P. April, 1918. Pp. 179.

Description of Manchurian Blast Furnace. By C. F. Wang. In B. F. & S. P. March, 1918. Pp. 109-111.

Dry-hot versus Cold-wet Blast Furnace Gas Cleaning. By Linn Bradley, H. D. Egbert and W. W. Strong. 1918. In Trans. A. I. M. E., V. 56. Pp. 303-318.

Electric Skip Hoists for Blast Furnaces. By David L.

Lindquist. In B. F. & S. P. May, 1918. Pp. 203-208. (Association Iron & Steel Electrical Engineers.)

Electrical Cleaning of Blast Furnace Gas. By H. D. Egbert. In B. F. & S. P. January, 1918. Pp. 39-43.

Fuel Economy in Blast Furnace Practice. By T. C. Hutchinson. In B. F. & S. P. September, 1918. Pp. 378-380. (British Iron and Steel Institute.)

Fuel Economy in Blast Furnace Practice. By T. C. Hutchinson. In B. F. & S. P. October, 1918. Pp. 419-420. (British Iron and Steel Institute.)

Gas Circulation in Regenerator Checkers. By A. D. Williams. In B. F. & S. P. January, 1918. Pp. 29-33.

Gas-firing Cowper Hot Blast Stoves. By T. M. Hunter. (Supplement of paper read before the Cleveland Institution of Engineers, Monday, Feb. 4, 1918). Abstract in I. & C. T. R., Feb. 8, 1918. P. 148.

Hochofenschlacke und Hochofengang. In Stahl und Eisen. Feb. 14, 1918. Pp. 135-136.

Hot Blast for Blast Furnaces. By O. Simmersbach. 1918. In Stahl und Eisen, Vol. 38, pp. 697-703.

Principal Changes in Blast Furnace Lines. By J. G. West, Jr. In B. F. & S. P. July, 1918. Pp. 289-296. (American Iron and Steel Institute.)

Principal Changes in Blast Furnace Lines. By J. G. West, Jr. In B. F. & S. P. August, 1918. Pp. 323-329. (American Iron & Steel Institute.)

Prevention of Blast Furnace Breakouts. By F. H. Wilcox. In B. F. & S. P. April, 1918. Pp. 174-178. (Bureau of Mines Bulletin 130.)

Problems of Hot Blast Stove Design. By A. D. Williams. In B. F. & S. P. February, 1918. Pp. 79-83.

Problems of Hot Blast Stove Design. By A. D. Williams. In B. F. & S. P. March, 1918. Pp. 114-117.

Problems of Hot Blast Stove Design. By A. D. Williams. In B. F. & S. P. April, 1918. Pp. 171-174.

Potash Recovery from Blast Furnace Dust. By R. A. Berry and D. N. McArthur. In B. F. & S. P. March, 1918. Pp. 130-134. (Society of Chemical Industry, England.)

Record of an Old Ferro-Silicon Furnace. By I. Peterman. In B. F. & S. P. December, 1918. Pp. 492-493.

Recovery of Potash From Blast Furnace Dust. By R. A. Berry. In Ind. Soc. Chem. Ind. Jan. 15, 1918. P. 1-5t.

Recovery of Potash From Blast Furnaces. By Linn Bradley. In Iron Age. Nov. 7, 1918. Pp. 1151-1153. From a paper read before the Fourth National Exposition of Chemical Industries, Sept. 25, 1918.

Slag Control in the Iron Blast Furnace by Means of Slag Viscosity Tables. By Alex. L. Feild. In Chem. and Met. Eng'g. Sept. 15, 1918. Pp. 294-300.

Spiegeleisen in Place of Ferromanganese. By Edwin F. Cone. In Iron Age. Jan. 3, 1918. Pp. 40, 41. and 129.

The Cottrell Process for Potash Recovery. By Linn Bradley. In B. F. & S. P. November, 1918. Pp. 457-459. (Fourth Nat'l. Exposition of Chemical Industries.)

Theory of Heat Conduction and Transfer. By A. D. Williams. In B. F. & S. P. May, 1918. Pp. 199-201.

Use of Bush Tuyeres on the Blast Furnace. By J. Hollinger. In B. F. & S. P. November, 1918. Pp. 467-470. (British Iron & Steel Institute.)

Unique Ladle Tilters at Casting Machine. By H. V. Schiefer. In B. F. & S. P. February, 1918. Pp. 84-85.

Das Umsetzen der Minnettehöfen und einige Ursachen unbeabsichtigter Wechsel in de Eisenqualitat. By Robert Newman. In Stahl und eisen. Jan. 3, 1918. Pp. 13-15.

Unique Feat in Blast Furnace Building. In Iron Age. April 18, 1918. Pp. 989-993.

Bessemer Process.

Non-Removal of Sulphur in Basic Bessemer Process. By L. Bhrm. 1918. In Stahl und Eisen. Vol. 38. Pp. 725-629.

Chemical.

Chemist's Part in Speeding Up Steel Output. By A. F. MacFarland. In Iron Age. June 27, 1918. Pp. 1645-1648.

Combustion Train for Carbon Determination. By J. B. Stetser and R. H. Norton. In Iron Age. Aug. 22, 1918. Pp. 443-445.

Dètermination des vitesses de refroidissement nécessaires pour realiser la trempe des aciers an carbone. By P. Chevenard. In Comptes Rendus. April 29, 1918. Pp. 682-685.

The Determination of Cobalt and Nickel in Cobalt Steel. By W. R. Schoeller and A. R. Powell. In Jnl. I. & S. Inst. 1918. Vol. 97. Pp. 441-445.

The Determination of Manganese in Steel in the Presence of Chromium and Vanadium by Electrometric Titration. By G. L. Kelley, M. G. Spencer, C. B. Illingworth and T. Gray. In Jnl. Ind. and Eng. Chem. Jan. 1918. Pp. 19-23.

Einfhiss der Chemischen Zusammensetzung auf die Eigenschaften des Eisens. In Stahl und Eisen. Jan. 3, 1918. Pp. 17-18.

Nickel and Cobalt Determination in Steel. By W. R. Schoeller and A. R. Powell. In B. F. & S. P. September. 1918. Pp. 359-360. (British Iron and Steel Institute.)

Rapid Determination of Carbon in Steel by the Barimm Carbonate Titration Method. By J. R. Cain and L. C. Maxwell. In Jnl. Ind. and Eng. Chem. July, 1918. Pp. 520-522.

Suggestions for the Steel Mill Chemist. By H. E. Moyer. In B. F. & S. P. March, 1918. Pp. 112-113.

Speeding Up the Steel Works Laboratory. By H. C. Kimber. In Chem. and Met. Eng'g. Sept. 28, 1918. Pp. 512-514.

Ueber die Bestimming des Sauerstoffs in Eisen. By P. Oberhoffer. In Stahl und Eisen. Feb. 7, 1918. Pp. 105-110.

Coke.

By-Product Coke Oven Pressure Regulation. By Frederick W. Ells. In B. F. & S. P. January, 1918. Pp. 21-22.

By-Product Coke Oven Plant at Minnequa. By H. B. Carpenter. In B. F. & S. P. March, 1918. Pp. 121-123.

By-Product Coke Oven Pressure Regulation. By Chas. H. Smoot. In B. F. & S. P. July, 1918. Pp. 306-310.

By-Product Coke Oven Pressure Regulation. By Chas. H. Smoot. In B. F. & S. P. August, 1918. Pp. 331-335.

By-Product Coke Oven and Its Products. By William H. Blauvelt. In Bul. A. I. M. E. March, 1918. Pp. 597-614.

Great By-Product Coke Plant at Clairton. In Iron Age. Jan. 3, 1918. P. 83.

Metallurgical Coke and the Recovery of By-Products. By W. A. Bone. In Colliery Guardian. Sept. 6, 1918. Pp. 498-499.

Preventing Leakage in Coke Ovens. By H. Grahn. In Colliery Guardian. Jan. 11, 1918. P. 71. (Translated from Gluckauf.)

The By-Product Coke Oven Industry." By William H. Blauvelt. In B. F. & S. P. June, 1918. Pp. 260-261. (American Iron & Steel Institute.)

Duplexing.

Steel Production by the Duplex Process. By J. K. Furst. In B. F. & S. P. January, 1918. Pp. 25-28.

Electrical.

Electricity as a Substitute for Gas. By Frank Thornton, Jr. In A. D. F. August, 1918. Pp. 324-325. (Engineers Society of Western Pennsylvania.)

Electrically Driven Mills at Bethlehem. By J. T. Sturtevant. In B. F. & S. P. October, 1918. Pp. 417-419. (Asso. Iron & Steel Elec. Engineers.)

Industrial Uses of Electrical Energy. In A. D. F. October, 1918. Pp. 392-394.

Installation and Care of Large Electrical Apparatus for Steel Mills. By O. Needham. In Elec. Jnl. Sept., 1918. Pp. 333-336.

Overhead Traveling Crane Bridge Motors. By R. H. McLain. In B. F. & S. P. October, 1918. Pp. 423-426. (Asso. Iron and Steel Elec. Engineers).

Operating Rules for Electric Cranes. In B. F. & S. P. October, 1918. Pp. 421-423. (Asso. Iron and Steel Elec. Engineers.)

Operation of Motor Driven Continuous Mills. By H. C. Cronk. In B. F. & S. P. August, 1918. Pp. 336-338. (Asso. Iron and Steel Elec. Engineers).

Remote Controlled Sub-station Described. In B. F. & S. P. October, 1918. Pp. 408-410. (Asso. Iron and Steel Elec. Engineers.)

Rolling Mill Electrification. In I. & C. T. R. June 21, 1918. P. 701.

Rolling Mills and the Electric Drive. By L. Rothera. In I. & C. T. R. Feb. 22, 1918. Pp. 196-197. (Abstract of paper read before the Manchester Association of Engineers.)

Standardizing Large Rolling Mill Motors. By K. Pauly. In B. F. & S. P. October, 1918. Pp. 411-414. (Asso. Iron and Steel Elec. Engineers.)

Standardization of Steel Industry Motors. In B. F. & S. P. May, 1918. Pp. 210-211.

"Selection of Steel Mill Auxiliary Motors. By J. D. Wright. In B. F. & S. P. April, 1918. Pp. 158-160. (Asso. Iron and Steel Elec. Engineers.)

Electric Furnaces.

Basic Lining for Electric Furnaces. By F. J. Ryan. In B. F. & S. P. November, 1918. Pp. 453-455. (American Foundrymen's Asso.)

Canada's Electric Steel Plant at Toronto. In Iron Age. April 25, 1918. Pp. 1053-1057.

Comment on Present Electrode Situation. In B. F. & S. P. October, 1918. Pp. 432-433.

Electric Steel for the Forging Industry. By Arthur V. Farr. In A. D. F. July, 1918. Pp. 264-267. (American Drop Forge Association.)

Electric Steel Production for Small Units. By Arthur V. Farr. In B. F. & S. P. September, 1918. Pp. 381-383. (American Drop Forge Association.)

Easily Handled Electric Furnace. In I. T. R. Oct. 31, 1918. Pp. 1019-1020.

Electric Carbon Tool Steel. By J. A. Holden. In Iron Age. May 9, 1918. P. 1223.

Electric Furnace and Steel Converter Compared. By C. R. Messinger. Borton Meeting American Foundrymen's Association.)

Electric Furnace Developments. By Donald F. Campbell. In I. & C. T. R. March 15, 1918. P. 281. (Abstract of paper read before the Faraday Society.)

Electric Furnace for Melting Alloys. By William H. Easton. In Elec. Wld. Aug. 17, 1918. Pp. 295-297.

Electric Furnace for Steel Castings. In Iron Age. May 16, 1918. Pp. 1282-1283.

The Electric Furnace in the Steel Casting Industry. By W. E. Moore. In Elec. Jnl. Sept., 1918. Pp. 331-332.

Electric Furnace in the Steel Foundry. By W. E. Moore. In Iron Age. Nov. 14, 1918. Pp. 1206-1207. (From a paper read at the convention of American Foundrymen's Association, Oct. 7 to 11, 1918.)

Electric Furnaces Produce Sound Tool Steel. By J. H. Mathews. In I. T. R. July 18, 1918. Pp. 152-153.

Electric Pig Iron from Steel Scrap. By Robert Turnbull. In Iron Age. Oct. 24, 1918. Pp. 1026-1027. (Paper read before American Electrochemistry Society, Oct. 1, 1918.)

Electric Smelting in Brazil. By Kirby Thomas. In Mining Engineer. (Reprinted in Iron Age. March 21, 1918. P. 778.)

Electric Steel. By F. D. Jones. In Machinery. Aug., 1918. Pp. 1104-1110.

Electric Steel Refining Furnaces. By James Bibby. In I. & C. T. R. Feb. 15, 1918. Pp. 165-167. (Read Feb. 14, 1918, before the Faraday Society.)

Der Elektrische Schmelgofen von Grönwell-Dixon. By Carl Irresberger. In Stahl und Eisen. Jan. 31, 1918. Pp. 90-92.

First Electric Furnace in South America. By Raymond S. Wile. In B. F. & S. P. January, 1918. Pp. 46-47.

Manufacture of Electric Tool Steel. E. A. Suverkrop. In American Machinist. Feb. 28, 1918. Pp. 351-358.

Manufacture of Ferro-Alloys in the Electric Furnace. By Robert M. Keeney. In Bul. A. I. M. E. Aug., 1918. Pp. 1321-1373.

New Booth-Hall Electric Steel Furnace. In B. F. & S. P. February, 1918. Pp. 75-76.

A New Electric Furnace. By Wirt S. Scott. In I. T. R. Aug. 22, 1918. Pp. 440-442.

Performance of Small Electric Furnace. In B. F. & S. P. November, 1918. Pp. 443-445.

Stobie 15-Ton Electric Furnace. In I. & C. T. R. April 12, 1918. Pp. 402-403.

The Triplex Electric Steel Process. By T. W. Robinson. In B. F. & S. P. June, 1918. Pp. 245-251. (American Iron and Steel Institute.)

The Paul Girod Electric Steel Furnace. In B. F. & S. P. May, 1918. Pp. 197-198.

The Webb Electric Steel Furnace. In Iron Age. Aug. 1, 1918. Pp. 257-260.

Forging.

A Progressive Forge Shop in Rockford. By Special Correspondent. In A. D. F. December, 1918. Pp. 480-481.

A Review of Present Day Forge Problems. By James C. Cran. In A. D. F. January, 1918. Pp. 22-24.

Drop Forge Possibilities After the War. By A. W. Peterson. In A. D. F. November, 1918. Pp. 433-435.

Drop Forgings Versus Steel Castings. In A. D. F. August, 1918. Pp. 305-306.

Equipment for Diversified Production. By A. B. Shuart. In A. D. F. November, 1918. Pp. 429-430.

Elementary Principles Used in Forging. By James C. Cran. In A. D. F. February, 1918. Pp. 66-69.

Electric Furnace Data for Ferro-Tungsten. By Robert M. Kenney. In B. F. & S. P. December, 1918. Pp. 486-487. (American Institute Mining Engineers.)

Electric Treatment of Airplane Forgings. By Dwight D. Miller. In Iron Age. Aug. 15, 1918. Pp. 381-385.

Forging Axles for Army Tank Trailers. In A. D. F. September, 1918. Pp. 343-344.

Gravity Conveyors for Shell Forgings. By H. E. Floercky. In A. D. F. February, 1918. Pp. 55-56.

Inspection of Forgings for War Work. By W. F. Rockwell. In A. D. F. September, 1918. Pp. 337-339.

Importance of Forging in Munition Making. By H. E. Floercky. In A. D. F. January, 1918. Pp 10-13.

Modern Forge Shop at the Essington Plant. In A. D. F. December, 1918. Pp. 474-475.

Making Ship Forgings at the Balboa Shops. By Special Correspondent. In A. D. F. February, 1918. Pp. 49-52.

Possibilities of the Forging Machine. By E. R. Hagen. In A. D. F. August, 1918. Pp. 304-305.

"Question of Correct Hammer Foundation. By Terrel Croft. In A. D. F. August, 1918. Pp. 300-304.

Question of Quenching Oils for Forgings. By Lewis H. McLlvried. In A. D. F. July, 1918. Pp. 271-272. (American Drop Forge Association.)

Some Drop Forge Possibilities Abroad. By L. W. Alwyn-Schmidt. In A. D. F. December, 1918. Pp. 471-473.

Solving Problems in the Forge Shop. In A. D. F. March, 1918. Pp. 92-93.

The Tractor, A Drop Forge Opportunity. In A. D. F. November, 1918. Pp. 441-442.

The Electrical System of the Forge Shop. By Edward McElvried. In A. D. F. July, 1918. Pp. 271-272. (American Drop Forge Association.)

The Problem of Forge Shop Design. By J. T. N. Hoyt. In A. D. F. July, 1918. Pp. 262-263. (Drop Forge Association.)

The Question of Fuel for the Forge Shop. By E. E. Adams. In A. D. F. June, 1918. Pp. 215-216.

The Installation of a New Steam Hammer. By W. J. Russell. In A. D. F. June, 1918. Pp. 213-215.

The Use of Grinding Wheels in Forge Shops. In A. D. F. January, 1918. Pp. 33-35.

The Forge Shop in the Automotive Industries. In A. D. F. January, 1918. Pp. 20-21.

The Advantages of Modern Sand Blasting. By A. W. Peterson. In A. D. F. January, 1918. Pp. 14-19.

Fuels.

Carbocoal Fuel Process Perfected. By Charles T. Malcomson. Abstract in I. T. R. Aug. 29, 1918. Pp. 496-497. (Presented at Sept. meeting of the A. I. M. E.)

Coal Thawing Plants. By S. W. Lynn. In Colliery Guardian. Feb. 1, 1918. Pp. 227-228.

Combustion Characteristics of Coals. In B. F. & S. P. December, 1918. Pp. 493-497.

Discussion of Article on Powdered Coal. In B. F. & S. P. August, 1918. Pp. 345-347.

A Diversified Application of Powdered Coal. By Charles Longnecker. In Iron Age. Sept. 12, 1918. Pp. 619-623. (Use in open hearth, annealing and other furnaces.)

Fuel Analysis of a Drop Forge Plant. By B. K. Read. In A. D. F. July, 1918. Pp. 268-270. (American Drop Forge Association.)

Fuel Analysis of a Drop Forge Plant. By B. K. Read. In A. D. F. August, 1918. Pp. 307-312. (American Drop Forge Association.)

Forge Shops, Past, Present and Future. In A. D. F. June, 1918. Pp. 217-221.

Forging, Heat Treating U. S. Model 1917 Rifle Parts. In A. D. F. January, 1918. Pp. 30-32.

Fuel Economies in Steel Mill Power Plant. By Jos. G. Worker. In B. F. & S. P. February, 1918. Pp. 86-87. (Asso. Iron and Steel Elec. Engineers.)

Fuel Economy in Modern Steel Works Unit. By Benj. Talbot. In I. & C. T. R. Aug. 23, 1918. P. 210.

Heating of Coal in Piles. By C. M. Young. In Bul. A. I. M. E. Feb., 1918. Pp. 211-212.

How to Store Your Coals. In I. T. R. July 4, 1918. P. 21.

Methods of a New System of Gas-Firing. By A. C. Ionides. In A. D. F. September, 1918. Pp. 365-367.

Making Substitutions for Natural Gas. By F. Denk. In B. F. & S. P. April, 1918. Pp. 156-158.

A New Method of Burning Powdered Coal. In Iron Age. 1918. Vol. 101. Pp. 545,549.

Producer Gas, Its Manufacture and Use. By Dr. C. S. Palmer. In A. D. F. September, 1918. Pp. 357-362. (Engineers' Society of Western Pennsylvania).

Powdered Fuel in Steam and Steel Plants. In Iron Age. March 7, 1918. Pp. 626-627.

Suggestions for Burning Pulverized Coal. By W. G. Wilcox. In A. D. F. December, 1918. Pp. 492-494. (American Chemical Society.)

Original from UNIVERSITY OF CHICAGO

Suggestions for Gas Producer Operation. By F. Denk. In B. F. & S. P. September, 1918. Pp. 386-388.

Substituting Powdered Coal for Other Fuels. By C. F. Herington. In B. F. & S. P. July, 1918. Pp. 285-288.

Saving Fuel in the Pittsburgh District. By W. Trinks. In B. F. & S. P. January, 1918. Pp. 22-24.

Safe Storage for Bituminous Coal. By J. F. Springer. In I. T. R. May 9, 1918. Pp. 1182-1187.

Some Applications of Coal Gas As a Furnace Fuel. By H. Hartley. In Ind. Soc. Chem. Ind. Feb. 28, 1918. Pp. 65-66R.

Storage and Weathering of Coal. By W. D. Stuckenberg and J. F. Kohout. In Power. Feb. 12, 1918. Pp. 234-235. (From paper read before the Kentucky Ice Manufacturers' Association.)

The Storage of Bituminous Coal. By John H. Anderson. In Power. Aug. 27, 1918. Pp. 321-322.

The Use of Coal in the Pulverized Form. By H. R. Collins. In A. D. F. September, 1918. Pp. 344-347. (American Institute Mining Engineers.)

Use of Powdered Fuel for Metallurgical Furnaces and for Steam-Raising. In I. & C. T. R. May 24, 1918. P. 588.

Heating Furnaces.

Automatic Shell Heating Treating Furnaces. By W. J. Harris, Jr. In Iron Age. Sept. 5, 1918. Pp. 565-568.

Equipment Data on Heat Treat Furnaces. In A. D. F. November, 1918. Pp. 437-439.

Electric Drying Ovens in a Rod Mill. In Iron Age. Feb. 14, 1918. Pp. 441-442.

Gas Furnaces; Their Running Cost and Output. By Ralph Halkett. In Gas Jnl. Vol. 141. Pp. 346-347.

Value of Heat Insulation in Furnaces. By A. W. Knight. In A. D. F. November, 1918. Pp. 451-453.

Wincott Furnaces. In Eng'g. April 19, 1918. Pp. 422-425. (Furnaces for heating billets and shells. Reheating furnace and gas producers.)

Heat Treating.

Application of Heat in Steel Treating. By A. F. MacFarland. In Iron Age. March 7, 1918. Pp. 612-614. (Read before Chicago section of the Steel Treating Research Society, Jan. 14, 1918.)

Correct Heat Treatment of Die Blocks. By Gustaf Peterson. In A. D. F. August, 1918. Pp. 295-297.

Changes in Dimensions of Heat-Treated Bars. In Iron Age. Aug. 1, 1918. Pp. 312-313.

Effect of Mass on Heat Treatment. By E. F. Law. In Jnl. of I. and S. Inst. Vol. 97. Pp. 333-352.

Electric Furnace for Heat Treatment. By T F. Bailey. (Presented before the Cleveland section of the Asso. of I. and S. Elec. Engrs. April 27, 1918.

High Explosive Shells and Shrapnel. By J. M. Hall. In A. D. F. December, 1918. Pp. 500-504. (Steel Treating Research Society.)

Heat Treatment of Automobile Springs. By M. E. Hendrickson. In A. D. F. October, 1918. Pp. 407-410. (Steel Treating Research Society.)

The Heat Treatment of Gear Blanks. By C. R. Poole. In A. D. F. June, 1918. Pp. 230-232. (American Gear Mfrs. Association.)

Heat Treating Problems in Shell Making. In A. D. F. April, 1918. Pp. 135-138.

Heat Treating Axles for the Army Truck. By A. W. Peterson. In A. D. F. March, 1918. Pp. 93-96.

Hardening and Tempering of Steel. By C. A. Edwards. In Eng'ng. March 8, 1918. Pp. 267-270. (Read before Manchester Association of Engineers. Feb. 9, 1918.

Heat Treatment of Steels. In I. T. R. Feb. 21, 1918. Pp. 487-488.

Influence of Heat Treatment on the Electrical and Thermal Resistivity and Thermo-Electric-Potential of Some Steels. By Edward D. Campbell and W. C. Dowd. In Jnl. I. & S. Inst. Vol. 96. Pp. 251-262.

The Manufacture of Steel Sheets. By Clement F. Poppleton. In Iron Age. March 14, 1918. Pp. 676-679. March 21, 1918. Pp. 740-742.

Note on the Warping of Steel Through Repeated Quenching. By J. H. Whiteley. In I. & C. T. R. Sept. 13, 1918. P. 290. (Abstract.)

The Electric Furnace for Heat Treating. By T. F. Baily. In A. D. F. July, 1918. Pp. 257-260. (American Drop Forge Association.)

The Time Effect in Tempering Steel. By A. E. Bellis. In B. F. & S. P. June, 1918. P. 271. (American Institute of Mining Engineers.)

Time Effect in Tempering Steel. By A. E. Bellis. In Bul. A. I. M. E. Feb., 1918. Pp. 331-333.

Using Electrical Furnaces for Annealing. By Wirt S. Scott. In A. D. F. August, 1918. Pp. 323. (Asso. Iron and Steel Electrical Engineers.)

Warping of Steel by Repeated Quenchings. By J. H. Whiteley. (Presented at the meeting of the Iron and Steel Institute, Sept. 13, 1918.)

Annealing by Muffle and Pot Ovens Compared. By Jos. B. Deisher. 1918. Boston Convention of the American Foundrymen's Association. The same. In Foundry. April. 1918. Pp. 154-158.

Trempe et Ecronissage des Aciers an Carbone. By F. Cloup. In Comptes-rendus. March 11, 1918. Pp. 415-416.

Ingots.

Causes of Defects in Steel Ingots. By J. N. Kilby. In Iron Age. Aug. 1-8, 1918. Pp. 266-269 and 369.

Cooling of Steel in Ingots and Other Forms. By J. E. Fletcher. 1918. Sept. meeting of the Iron and Steel Inst.

Cutting Steel Ingots With Oxy-Hydrogen. By W. B. Perdue. In I. T. R. Aug. 29, 1918. Pp. 504-505.

Defects in Steel Ingots. By J. N. Kilby. In Jnl. Ir. & St. Inst. Vol. 97, Pp. 365-385.

Dish-Cast Steel Ingots. In Iron Age. Oct. 3, 1918. P. 869.

Making Sand Cast Forging Ingots. By W. L. Booth. In Iron Age. Nov. 7, 1918. Pp. 1139-1140. (Originally appeared in the October issue of Metal Trade.)

Production of Sound Steel by Lateral Compression of the Top Portion of the Ingot. By Benjamin Talbot. In Jnl. Ir. & St. Inst. Vol. 97. Pp. 221-238.

Stripping Ingots with Electric Magnet. In B. F. & S. P. February, 1918. P. 88.

Iron Ores.

Notes on Certain Iron Ore Resources of the World. By E. C. Harder, W. Lindgren, C. M. Weld, A. C. Spencer, H. F. Bain and S. Paige. In Bul. A. I. M. E Sept., 1918. Pp. 1471-1496.

Using Manganese Ore and Alloys in Sweden. In Iron Age. April 11, 1918. Pp. 938-940.

Metallurgy.

Effect of the Presence of a Small Amount of Copper in Medium-Carbon Steel. By Carl R. Hayward and A. B. Johnston. 1918. In Bul. A. I. M. E. Pp. 159-167.

Inspecting the Structure of Metals. By J. J. McIntyre. In A. D. F. November, 1918. Pp. 443-444.

Iron, Carbon and Phosphorus. By J. E. Stead. 1918. In Jnl. Ir. & St. Inst. Vol. 97. Pp. 389-415.

La macrostructure de l'acier By A. Portevin and V Bernard. In Rev. Metallurgie. May-June, 1918. Pp. 273-280.

Malleable Cast Iron. By E. Adamson. In Colliery Guardian. Jan. 18, 1918. Pp. 124-125. (Taken from paper read before the Staffordshire Iron and Steel Institute.)

Manganese from Steel Slags. 1918. In Mining Sci. Press. Vol. 116. P. 486.

Note on Inclusions in Steel and Ferrite Lines. By J. E. Stead. 1918. In Jnl. Ir. & St. Inst. Vol. 97. Pp. 287-292. Discussion Pp. 293-303.

Occluded Gas in Ferrous Alloys. By Gelbert Alleman and Charles J. Darlington. Jnl. Franklin Inst. Feb., 1918. Pp. 161-198. March, 1918. Pp. 333-357. April, 1918. Pp. 461-480.

Origin of the Oxygen Compounds Found in Steel. By Cosmo Johns. In Jnl. Soc. Chem. Ind. April, 30, 1918. Pp. 145-146R.

Rate of Change in Electrical Resistance of Hardened Steel at 100 deg. C. and Ordinary Temperatures. By E. D. Campbell. In I. & C. T. R. Sept. 13, 1918. P. 291. (Abstract.)

The Sumner Elastic Limit Recorder. By J. L. Jones and C. H. Marshall. In A. D. F. September, 1918. Pp. 341-342. (American Society for Testing Materials)

The Use and Abuse of Scleroscopes. By A. J. Smith. In A. D. F. June, 1918. Pp. 212-213.

The Conservation of Manganese. By C. R. Ellicott. In B. F. & S. P. June, 1918. Pp. 252-256. (American Iron and Steel Institute.)

The Microscope to Detect Steel Impurities. By John McConnell. In B. F. & S. P. May, 1918. Pp. 219-221.

Tensile Strength and Hardness of Steel. By H. M. Brayton. In Iron Age Sept. 12, 1918. Pp. 627-629.

Uses of Zirconia in Steel Metallurgy. In Iron Age. May 16, 1918. Pp. 1276-1277.

Digitized by Google Original from UNIVERSITY OF CHICAGO

Open Hearth Process.

Acid Open Hearth Steel Investigation. By T. D. Morgans and F. Rogers. In B. F. & S. P. May, 1918. Pp. 216-217. (British Iron and Steel Institute)

Description of Small Open Hearth Furnace. By David McLain. In B. F. & S. P. March, 1918. P. 135.

Liquid Ferro-Manganese in Open Hearth. By E. C. Hummel. In B. F. & S. P. May, 1918. Pp. 201-202.

Principles of Open Hearth Furnace Design. By Chas. H. F. Bagley In B F. & S. P. November, 1918. Pp. 471. (British Iron and Steel Institute.)

Principles of Open Hearth Furnace Design. Chas. H. F. Bagley. In B. F. & S. P. December, 1918. Pp. 505-507. (British Iron and Steel Institute)

Phosphorous in Soft Open Hearth Steel. By J. S. Unger. In B. F. & S. P. June, 1918. Pp. 256-259. (American Iron and Steel Institute.)

Phosphorus in Soft Open Hearth Steel. By J. S. Unger. In B. F. & S. P. July, 1918. Pp. 302-306. (American Iron and Steel Institute)

Progress in Open Hearth Practice Reviewed. By John McConnell. In B. F. & S. P. January, 1918. Pp. 44-46.

Utilization of Basic Open Hearth Slag. In B. F. & S. P. August, 1918. P. 322 (Society of Chemical Industry)

Waste Heat from Open Hearth Furnaces. By Thos. B. Mackenzie. In B. F. & S. P. November, 1918. Pp. 460-465. (British Iron and Steel Institute.)

Waste Heat from Open Hearth Furnaces By Thos. B. Mackenzie. In B. F. & S. P. December, 1918. Pp. 488-492. (British Iron and Steel Institute.)

Pickling.

Niter Cake Substitute for Pickling Steel. By E. E. Corbett. In B. F. & S. P. December, 1918. Pp. 497-501.

Plant Descriptions.

Ansaldo Steel Plants Rush Munitions. By Mario De Biasi. In B. F. & S. P. September, 1918. Pp. 258.

Handling Coal and Ash at Youngstown. In Iron Age. Aug. 8, 1918. Pp. 367-368. (Arrangement of equipment at Republic Iron and Steel Company.)

Liberty Mill of the Carnegie Steel Company. In Iron Age. Jan. 3, 1918. Pp. 18-22.

Modern Blast Furnaces at Portsmouth, Ohio. In B. F. & S. P. April, 1918. Pp. 153-155.

Modern German Blast Furnace Plant. In I. & C. T. R June 21, 1918. Pp. 710-711.

New Installation for Rolling Alloy Strips. In B. F. & S. P. August, 1918. Pp. 319-321.

New Dwight and Lloyd Sintering Machine. In B. F. & S. P. February, 1928. Pp. 77-78.

New Plant of the Keystone Steel & Wire Co. By John T. Eaton. In B. F. & S. P. January, 1918. Pp. 12-16.

A New Chinese Iron and Steel Plant In Iron Age. Feb. 7. 1918. Pp. 386-388.

New Iroquois Furnace Now in Blast. In I. T. R. May 16, 1918. Pp. 1237-1242.

New Plant of Canton Sheet Steel Company. By John D. Knox. In I. T. R. March 7, 1918. Pp. 595-599.

Trumbull Steel Company's Strip Mills. In I. T. R. April 28, 1918. Pp. 971-975.

Youngstown Sheet and Tube Plate Mill. In B. F. & S. P. July, 1918. Pp. 281-284.

Power Plants.

Modern Condenser Practice Considerations. By D. D. Pendleton. In B. F. & S. P. April, 1928. Pp. 164-170. (Engineers Society of Western Pennsylvania.)

Problems of Steam Cylinder Lubrication. By W. F. Osborne. In B. F. & S. P. August, 1918. Pp. 338-339-341.

Problems of Steam Cylinder Lubrication. By W. F. Osborne. In B. F. & S. P. September, 1918. Pp. 389.

Problems of Steam Cylinder Lubrication. By W. F. Osborne. In B. F. & S. P. October, 1918. Pp. 414-416.

Steam Turbine Progress and Possibilities. In B. F. & S. P. December, 1918. Pp. 481-483.

Steel Industry Belt Drive Applications. By Charles A. Hirschberg. In B. F. & S. P. May, 1918. Pp. 214-215.

Turbine Gives Additional Line Shaft Power. In B. F. & S. P. October, 1918. Pp. 430-432.

Test on Rotary Blowers and Exhausters. In B. F. & S. P. July, 1918. Pp. 298-299.

Production Efficiency.

Conservation of Materials in Our Plants. By Francis G. Hall. In A. D. F. October, 1918. Pp. 395-396.

Conservation of Materials in Our Plants. By Francis G. Hall. In A. D. F. November, 1918. Pp. 440-441.

Conservation of our Human Equipment. By Earl B. Morgan. In A. D. F. June, 1918. Pp. 221-224.

Conservation of Our Human Equipment. By Earl B. Morgan. In A. D. F. August, 1918. Pp. 316-318.

Character Analysis and the Man Problem. By William J. Kirby. In A. D. F. February, 1918. Pp. 69-71. (American Foundrymen's Association.)

Environment Versus Production in Shops. By F. E. Merriam. In A. D. F. March, 1918. Pp. 87-88.

Educating Steel Mill Electrical Employes. In B. F. & S. P. October, 1918. Pp. 427-430. (Asso. Iron and Steel Elec. Engineers.)

Laws Relating to Factory Lighting. By W. T. Blackwell. In A. D. F. August, 1918. Pp. 312-313.

Natural Ventilation for Forge Shops. By F. M. Paull. In A. D. F. March, 1918. Pp. 97-98. (Detroit Steel Products Company.)

Recent Advances in Steel Mill Lighting. By Ward Harrison. In B. F. & S. P. January, 1918. Pp. 69-72. Association Iron and Steel Elec. Engineers.)

Specialized Forge Shop Production. By A. W. Peterson. In A. D. F. June, 1918. Pp. 209-212.

Steel Mill Lighting and War Economy. By Lieut. Samuel G. Hilbin. In B. F. & S. P. March, 1918. Pp. 126-129.

Solving the Problems of Steel Mill Lighting. By Ward Harrison. In B. F. & S. P. January, 1918. Pp. 36-38.

The Cultivation of Shop Efficiency. By H. J. MacMillan. In A. D. F. November, 1918. Pp. 446-447.

Transportation Problems in Forge Shops. By A. W. Peterson. In A. D. F. May, 1918. Pp. 165-167.

The Benefits of Good Shop Illumination. W. T. Blackwell. In A. D. F. March, 1918. Pp. 99-100.

Telautographs Expedite Steel Production. By H. C. Snyder. In B. F. & S. P. May, 1918. Pp. 211-213.

Refractories.

The Corrosive Action of Flue Dust on Firebricks. By J. W. Mellor and W. Emery. In I. & C. T. R. Oct. 25, 1918. P. 460. (Abstract of paper read before the Swansea meeting of the Refractory Materials Section of the Ceramic Society.)

Essential Properties of Refractories Used in Steel Production. By Alleyne Reynolds. In I. & C. T. R. May 24, 1918. P. 586. (Abstract of paper read before the Ceramic Society.)

Magnesite and Magnesite Brick. By W. Donald. Monthly meeting of the Ceramic Society. March 9, 1918.

Slag Temperature Influence on Refractories. By Raymond M. Howe. In B. F. & S. P. December, 1918. Pp. 484-485. (Refractories Manufacturers Association.)

Selecting Suitable Refractory Material. By I. W. Haulman. In B. F. & S. P. June, 1918. Pp. 243-244.

Silica Brick in Open Hearth Furnaces. By M. Bied. In Comptes-rendus. May 13, 1918. Pp. 776-778. (Translated by E. C. Buck. In Iron Age, Aug. 1. 1918. Pp. 270-273.

Testing and Inspection of Refractory Brick. By C. E. Nesbit and M. L. Bell. In B. F. & S. P. August, 1918. Pp. 341-345. (American Society for Testing Materials.)

Rolling.

Blooming Mill Connecting Rod Repair. In B. F. & S. P. February, 1918. P. 65.

Design of Blooming Mills. By H. H. Hummel. In Iron Age. March 28, 1918. Pp. 793-797.

Elements of Roll Pass Design. By W. Trinks. In B. F. & S. P. February, 1918. Pp. 66-68.

Elements of Roll Pass Design. By W. Trinks. In B. F. & S. P. March, 1918. Pp. 124-126.

Elements of Roll Pass Design. By W. Trinks. In B. F. & S. P. April, 1918. Pp. 160-163.

Elements of Roll Pass Design. By W. Trinks. In B. F. & S. P. May, 1918. Pp. 208-209.

The Elements of Roll Pass Design. By W. Trinks. In B. F. & S. P. June, 1918. Pp. 262-264.

The Elements of Roll Pass Design. By W. Trinks. In B. F. & S. P. July, 1918. Pp. 300-302.

Einfhus der Warmebehandling. In Stahl und eisen. Jan. 10, 1918. Pp. 38-39.

Flywheels for Rolling Mill Application. By G. E. Stoltz In B. F. & S. P. January, 1918. Pp. 17-21. (Association of Iron and Steel Elec. Engineers.)

Practical Pointers on Wire Rod Rolls. By W. S. Standiford. In B. F. & S. P. September, 1918. Pp. 367-369.

Plate Production Expedites Shipbuilding. By Alfred M. Staehle. In B. F. & S. P. September, 1918. Pp. 361-365.

Standardized Tests for Refractories. By Cosmo Johns F. G. S. In A. D. F. October, 1918. Pp. 310-413. (Iron and Steel Institute.)

Steels.

A Summary of Iron and Steel Processes. By Eliot A. Kebler. In B. F. & S. P. July, 1918. Pp. 296-297.

Change of Expansion of Nickel Steel Produced by Thermal or Mechanical Treatment. By C. E. Guillaume. In Arch. Sci. Phys. Nat. Vol. 45. Pp. 407-417.

Conserving Manganese in Steel Production. By A. N. Diehl. In B. F. & S. P. September, 1918. Pp. 366-367. (American Iron and Steel Institute.)

Composition and Properties of Steels. By Howard Ensaw. In American Machinist. Oct. 10, 1918. Pp. 669-672.

Damascene Steel. By N. Belaiew. In Jnl. Ir. & St. Inst. Vol. 97 Pp. 417-437.

Development of Metallurgy of Titanium. By Auguste J. Rossi. In Met. and Chem. Eng'g. Feb. 1, 1918. Pp. 117-120.

Ferro-Alloys, Manufacture and Properties. By J. W. Richards. In B. F. & S. P. November, 1918. Pp. 448-551.

Fifty Years of Iron and Steel. By Joseph G. Butler. In B. F. & S. P. January, 1918. Pp. 1-9. (American Iron and Steel Institute.)

French Steel Industry in War Time. In Iron Age. June 20, 1918. Pp. 1628-1629.

Influences of Hot Deformation on Steel. By George Charpy, Paris. In A. D. F. December, 1918. Pp. 482-488. (Iron and Steel Institute.)

Influences of Hot Deformation on Steel. By Georges By Georges Charpy. In I. & C. T. R. Sept. 13, 1918. Pp. 289-290. (Abstract.)

Influence of Some Elements on Tenacity of Basic Steel. By Andrew McWilliam. In I. & C. T. R. Sept. 13, 1918. Pp. 290-291. (Abstract.)

The Influences of Surface Tension. By F. C. Thompson. In I. T. R. May 23, 1918. Pp. 1299-1304. (Deals with the influence that surface tension has on the structure of iron and steel.)

Japanese Development in Steel Making. By Thomas T. Read. In Iron Age. May 16, 1918. Pp. 1259-1262.

Die Konstitution des Eisens und Seiner Legieungen. In Stahl und Eisen. Jan. 3, 1918. Pp. 15-17.

Modern Methods of Making Tool Steel. By Frank B. Lounsberry. In A. D. F. October, 1918. Pp. 404-407. (Steel Treating Research Society.)

New Air Hardening High Speed Steel. In A. D. F. November, 1918. Pp. 435-436.

Nicu Steel and Its Manufacture. By G. M. Colvocoresses. In Can. Chem. Jnl. Vol. 2. Pp. 108-110, 121-123.

Non-metallic Inclusions; Their Constitution and Occurrence in Steel. By A. McCance. In Jnl. Ir. & St. Inst. Vol. 97. Pp. 239-286.

Steel, Its Selection and Treatment. By Prof. John F. Keller. In A. D. F . February, 1918. Pp. 52-55. (Steel Treating Research Society.)

Steel, Its Selection and Treatment. By Prof. John F. Keller. In A. D. F. April, 1918. Pp. 141-144. (Steel Treating Research Society.)

Steels for Gears and Their Treatment. By George A. Richardson. (Meeting American Drop Forge Association, June 20, 1918.)

Summary of Attempted Improvements in the Puddling Process. In Jnl. West of Scotland. Ir. & St. Inst. January-February, 1918. Pp. 195-227.

Steel Castings.

Cast Iron at High Temperatures. In Power. July 23, 1918. Pp. 120-121.

How Steel Castings Are Made in California. In Foundry. March. 1918. Pp. 129-132.

Making Cast Ammunition in France. By E. Roncray. In Iron Age. March 7, 1918. Pp. 606-608. (How semi-steel shells are made.)

Making French Shells of Semi-Steel. In I. T. R. March 14, 1918. Pp. 666-668.

A New Gas Fired Furnace for Refining Iron. By. George H. Manlove. In Foundry. June, 1918. Pp. 282-286.

Overcoming Troubles in Cupola Operations. By Paul R. Ramp. In Iron Age. April 11, 1918. Pp. 946-948.

Producing Army Ordnance Steel Casting. By Capt. E. R. Swanson. In B. F. & S. P. November, 1918. Pp. 455-456. (American Foundrymen's Association.)

Die Ranmverteilung in Stahlformgiessereien. By Carl Irresberger. In Stahl urd Eisen. Feb. 28, 1918. Pp. 170-172.

Steel Casting Development in the West. By J. D. Fenstermacher. In B. F. & S. P. November, 1918. Pp. 452-453. (American Foundrymen's Association, Milwaukee meeting.)

Die Voransbestionmung der Fuchs und Gichttemperatur Berm Giessereiflammofen und Kuppelofen als Beispel Entwickelt. By Bergrat Bernhard Osann. In Stahl und Eisen. Jan. 31, 1918. Pp. 85-89.

Temper Measuring.

Automatic Control of High Temperatures. By R. P. Brown. In A. D. F. February, 1918. Pp. 72-74. (Farraday Society of London.)

High Temperatures and Artificial Gas. By E. Raven Rosen-Baum. In A. D. F. May, 1918. Pp. 186-189. (Industrial Fuel Sessions, Minneapolis, Minn.)

Pyrometry and Its Several Limitations. By Chas. B. Thwing, Ph. D. In A. D. F. March, 1918. Pp. 108-112. (Steel Treating Research Society at Detroit, Mich.)

Welding.

Marine Welding at the Balboa Shops. By Special Correspondent. In A. D. F. March, 1918. Pp. 89-92.

Several Good Suggestions on Welding. By James C. Cran. In A. D. F. March, 1918. Pp. 104-106.

Several Good Suggestions on Welding. By James C. Cran. In A. D. F. April, 1918. Pp. 146-147.

The Welding of Iron and Steel. By W. H. Cathcart. In Jnl. West of Scotland. Ir. & St. Inst. April, 1918. Pp. 327-347.

Electric Arc Welding—A New Industry. By H. A. Horner. In A. D. F. October, 1918. Pp. 396-401. (American Institute of Elec. Engineers.)

PIG IRON STATISTICS.

The following statistics showing prices and production of pig iron during and after previous wars have been sent to Mr. Gary by Eliot A. Kebler, special representative of the Matthew Addy Company:

Elbert H. Gary, president U. S. Steel Corporation, 61
Broadway, New York City.

Dear Mr. Gary: The following pig iron statistics may be of interest, as they point to your era of great prosperity for America.

Advance in pig iron prices after wars.

Russian-Japanese War—	
War declared February 10, 1904—Valley Bessemer	$12.64
War ended September 9, 1905—Valley Bessemer	14.95
Price May, 1907—Valley Bessemer	23.28
Spanish War—	
Really began January, 1898—Valley Bessemer	9.12
War declared April, 1898—Valley Bessemer	9.66
War ended August, 1898—Valley Bessemer	9.60
Price, December, 1900—Valley Bessemer	24.20
Franco-Prussian War—	
War declared July 10, 1870—No. 1 foundry, Philadelphia	32.75
War ended May, 1871—No. 1 foundry, Philadelphia	35.50
Price, June, 1872—No. 1 foundry, Philadelphia	53.37
Civil War—	
October, 1862—No. 1 foundry, Philadelphia	18.61
August, 1864—No. 1 foundry, Philadelphia (gold basis)	29.44
Average, year 1866—No. 1 foundry, Philadelphia	46.67

Shortage of pig iron capacity shown by comparison with steel:

	Jan. 1, 1914	Jan. 1, 1919	Increase
Steel	37,000,000	52,500,000	36%
Pig iron	40,000,000	44,000,000	only 10%

This is also shown by a comparison of production with the doubling of output each 10 years, in million tons as follows:

10-Year Periods	Tons Made	The Doubling Rule
1850-9	6.4	6.2
1860-9	10.5	12.4
1870-9	21.9	24.7
1880-9	51.5	49.5
1890-9	93.5	98.9
1900-9	197.8	197.8
1910-9		197.8

1910-8 ....281.8
1919 say 44.0

Less 1910-9 say 325.8

Apparent shortage January 1, 1920, say, in millions tons, 70.

Of course, even the strong pig iron position shown above will not prevent the temporary recession in price during the reconstruction period.

Principles of Open Hearth Furnace Design

Further Considerations of Furnace Dimensions Based on Gas Port Area and Hearth Area Per Ton of Steel Capacity. Other Calculations Obtained and Shown.

By CHARLES H. F. BAGLEY.

PART III.

In designing an actual furnace there are two leading dimensions required as a basis, viz. gas-port area and hearth area per ton of steel capacity, from which the rest may then be calculated. These data are best taken from practical experience with successful furnaces, but with due regard to other working conditions; for practice and circumstances are very variable in both respects.

Hearth Area—In this country a hearth area of 5 to 6 square feet per ton is usually allowed for acid furnaces, and 6 to 8 square feet per ton for basic (fixed) furnaces. Continental and American furnaces often have a larger allowance than this and a shallower bath acordingly (especially in the case of the smaller furnaces) and would be made to hold a larger charge, and rated at a higher capacity in this country. Which is the better practice is purely a matter of opinion, largely influenced at home by the factor of wages rates. In any case, the author prefers the English practice of charging as much as the furnace can comfortably hold, if the maximum output is required, but the point should not be overlooked in making comparisons with lower-rated foreign furnaces. Large tilting-furnaces, working the Talbot process, etc., are, of course, much deeper than fixed furnaces of otherwise similar dimensions, and may hold nearly double the weight of steel accordingly; so that output comparisons on the basis of nominal capacities are altogether misleading, independent of differences in the practice followed and raw materials employed. The only proper basis of comparison of different furnaces on similar practice seems to be their respective outputs per unit of hearth area.

Gas-Port Area—Practice in this respect is very variable, but an allowance of 4 square inches per ton for acid furnaces and 5 square inches for basic furnaces is usually satisfactory. This factor is really proportional to the hearth area, independent of its depth, and is preferably stated in square inches per unit of hearth area—i.e. for acid and basic fixed furnaces, 0.70-0.80 square inches per square foot of hearth. Personally the author prefers larger areas both for gas and air ports—subject to proper control at valves—and, of course, in due proportion to each other.

For a fixed 100-ton basic open-hearth furnace, on these lines (see Fig. 1), the leading dimensions are:

Hearth. At 7 square feet per ton = 700 square feet = 50 ft. 0 ins. × 14 ft. 0 ins. or equal.

Hearth. At 7 square feet per ton = 700 square feet = 46 ft. 8 ins. × 15 ft. 0 ins. or equal.

Gas Ports. At 0.80 sq. in. per ft. hearth = 560 sq. in. = 24 ins. × 24 ins., or equal.

Air Ports. At 2.25 times gas ports = 1260 square inches = 1 overhead type 10 ft. 6 ins. × 0 ins./15 ins.; or 2 ordinary ports 25 ins. × 25 ins. each, or equal.

Uptakes—Uptakes may be considerably larger than their port areas, to minimize friction and wear of brickwork, etc., but should remain in correct proportion to each other, as a check on the ratio of port areas.

Gas uptakes say 720 sq. ins. = 24 ins. × 30 ins. each, or equal.
Air uptakes say 1620 sq. ins. = 27 ins. × 30 ins. each, or equal.

Slag Pockets and Bridge Arches—To suit structural requirements and to connect smoothly with checker chambers; areas to be well in excess of uptake areas; slag pockets faced with false walls, and half filled with perished dolomite or other suitable material, and should not be too deep, if the slag is to be tapped out molten.

Checker Chambers—Depth of checkerwork 15 feet 0 inches if possible; the top course to be 2 feet 0 inches or so below the bridge for protection and for even diffusion of gases. To provide ample heating surface and reduce the velocity and friction of gases, and to allow for gradual "silting up," the horizontal area of the open spaces should be at least eight or 10 times the port areas, and in proportion as before. The length of gas and air chambers being equal, their widths will be in the like proportion (1.00/2.25), which, however, makes rather an awkward design, and I therefore prefer to employ different types of checker work in the two chambers and to adjust their relative widths accordingly. This may be done by using 6 inch by 6 inch open flue type checkerwork in the air chambers, and 6 inch by 3 inch open flue or 6 inch by 6 inch single checked brickwork in the gas; the width of the gas chamber being doubled to keep the total passage areas in proportion. In the 6 inch by 6 inch open flue type—plan view—the open spaces are four-ninths, and the bricks five-ninths of the total area; whereas in the 6 inch by 3 inch open flue or 6 inch by 6 inch single checked types the spaces amount

---

Last installment of paper read by the author before the British Iron and Steel Institute.

to only two-ninths and the bricks to seven-ninths of the total area.

The gas-port area was taken at 560 square inches and the air port at 1,260 square inches, which, multiplied by 8, gives 31.1 square feet and 70.0 square feet of spaces required in gas and air checkerwork respectively. The gas chamber area will therefore be:

For 6 ins. × 6 ins. checker work, 9/4 × 31.1 = 70 sq. ft. = 14 ft. 0 ins. long × 5 ft. 0 ins. wide, or equal.
For 6 ins. × 3 ins. checker work, 9/2 × 31.1 = 140 sq. ft. = 14 ft. 0 ins. long × 10 ft. 0 ins. wide, or equal.

and the air-chamber area (with 6 ×6 checkerwork):

9/4 × 70 = 158 sq. ft. = 14 ft. 0 ins. long × 11 ft. 3 ins. wide, or equal.

The thickness of any false facing walls or solid partitions to be added to above sizes.

It is possible, though unusual, for the checker chambers to be too large, and the author has known furnaces which would not work properly until their chambers had been reduced in length by nearly half.

Chimney Flues—As already noted, it is important that the proportion between gas and air flues should be observed. As regards area, the temperature of waste gases in the flues being reduced to 600 degrees C. (or under), their total volume will be reduced to two-fifths (or less) of that passing through the ports; and the flue areas could be reduced accordingly, with allowance for deposit and accumulation of flue dust, and for air leakages, etc. But they may well be made several times larger than this, and are preferably designed to correspond approximately with the chimney area in order to avoid sudden change of velocity. It is quite unnecessary, and probably undesirable, to make them too large, the result being simply to reduce the effectiveness of the ratio of air to gas areas. There is obviously no need to make the flue areas any larger than the port areas—in the present case 560 square inches and 1,260 square inches respectively, and together 1,820 square inches.

The point is also of interest in connection with dimensions of collecting flues below the checkerwork and the height and thickness of bearer walls, which are frequently built needlessly tall and thin and excessively weak for the weight they have to carry—and also in connection with plans for waste-heat boiler, etc.

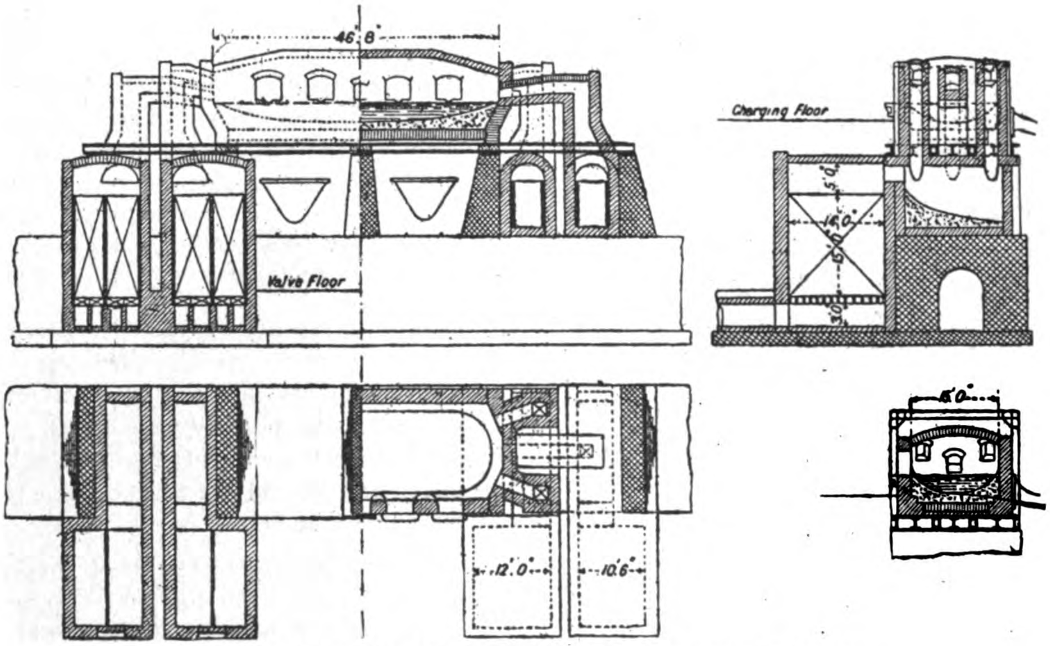


Fig. 1—Design for 100-ton basic furnace as per calculations.

On this basis, the flues being equal in depth, their respective widths will be in ratio of 2.25/1.00, and the dimensions will be approximately:

For gas flue, 560 sq. ins. = 2 ft. 0 ins. deep × 23 ins. wide.
For air flue, 1260 sq. ins. = 2 ft. 0 ins. deep × 52 ins wide.
Plus 12"–18" allowance in depth.

for flue accumulation, which brings their combined area reasonably near that of a 5 feet 0 inches diameter chimney.

The table on page 113 gives the leading dimensions for furnaces of various sizes from the above data and on the same lines.

Chimney valves should, of course correspond to flue areas, and must be large enough to avoid any in-

---

The reader's attention is called to the fact that installments I and II of this series, appeared in the November and December issues of THE BLAST FURNACE AND STEEL PLANT, and that many references are more easily understood by a study of the first two articles.

fluence on the proportioning of the flues.

N. B.—With the same gas and only 10 per cent excess air, the ratio comes down to 2.00/1.00.

Waste-Heat Boilers.

It is often considered a mistake to place boilers in the chimney flues of regenerative furnaces, on the ground that if regeneration is reasonably efficient there should be no material waste heat available, but the consumption of coal by a large open-hearth furnace—approximately 300 tons per 1,000 tons of ingots made—is sufficient to yield a great deal of steam, even on a very low evaporative basis, and there usually is a very material surplus heat in the gases passing up the chimney during at least some stages of the melt, if not during the later half of every reversal period. The lower strata of checkerwork may at times be cooled down to a black heat by the cold incoming air, but in the gas chamber they can never fall below the temperature of the incoming gas—so that the outgoing gases can never be cooled down on reversal to that temperature. The boiler's opportunity does, of course, depend on the thermal efficiency, or otherwise, of the regenerators and the length of the flues between them and the chimney; but, as already noted, the practical purpose of regeneration is not so much in extraction and economy of heat units, but in the provision and maintenance of high temperatures to the gas and air supplies—which is not quite the same thing as thermal efficiency. Checker chambers are rarely deep enough for high thermal efficiency, and considerable margin is therefore usually available for raising steam. Under suitable conditions, evaporation varies from one up to 3 lbs. of steam per pound of coal burned in the producers—though the latter figure must indicate very poor regeneration.

Capacity	20 Tons.	40 Tons.	60 Tons.	80 Tons.	100 Tons.
Hearth area at 7 sq. ft. ton	140 sq. ft.	280 sq. ft.	420 sq. ft.	560 sq. ft.	700 sq. ft.
Equivalent dimensions, say	17′ 6″ × 8′ 0″	28′ × 10′	35′ × 12′	40′ × 14′	50′ × 14′
Gas-port area at 80 sq. in.	112 sq. ft.	224 sq. ft.	336 sq. ft.	448 sq. ft.	560 sq. ft.
Equivalent dimensions	10″ × 11″	15″ × 15″	18″ × 18″½	22″ × 20½″	24″ × 23″
Air-port area at 2.25 gas	252 sq. ins.	504 sq. ins.	576 sq. ins.	1008 sq. ins.	1260 sq. ins.
Equivalent dimensions	2 (10″ × 12½″)	2(15″ × 16½″)	2 (18″ × 21″)	2 (22″ × 23″)	2 (24″ × 26″)
Gas-checker chamber (6″ × 3″	28 sq. ft.	56 sq. ft.	84 sq. ft.	112 sq. ft.	140 sq. ft.
Equivalent dimensions	4′ × 7′	7′ × 8′	7′ × 12′	9′ × 12′ 6″	10′ × 14′
Air-checker chambers (6″ × 6″)	31½ sq. ft.	63 sq. ft.	94½ sq. ft.	126 sq. ft.	157½ sq. ft.
Equivalent dimensions	4′ 6″ × 7′	7′ 10″ × 8′	7′ 10″ × 12′	10′ × 12′ 6″	11′ 3″ × 14′
Chimney flues, gas (12″)	11″ × 22″	15″ × 27″	18″ × 30″	22″ × 33″	24″ × 36″
Chimney flues, air (12″)	25″ × 22″	34″ ½ 27″	40″ × 30″	50″ × 33″	54″ × 36″
Equivalent chimney diameter	33″	41″	48″	54″	59″

Actual chimney diameters should be calculated by the ordinary rules and will usually be larger than as given above; but these diameters should suffice if the height is correct.

Waste-heat boilers should be specially designed and well above their work as regards flue areas and heating surface, or results will be disappointing: for though evaporation may be only one pound of steam per pound of coal, the gases passing are virtually the same as if the coal were burning under it, or possibly eight times as much as through a coal-fired boiler doing the same duty. These dimensions depend on the weight of coal consumed, not upon the steam raised. Waste-heat boilers are usually fitted with mechanical induced draught plant, instead of the more reliable static chimney. By attention to flue and valve design, so as to do away with all obstruction other than the boiler, it is surely possible to dispense with mechanical draught and to retain the plain chimney and add sufficient to its height to equalize matters. The operation and output of the furnace must always be the first consideration.

Conclusion.

Such are the general principles of open-hearth furnace design; and the author feels that if more attention were paid to their correct application, better performances would very often result. The data and assumptions made may not always correspond with actual conditions; but it is not a difficult matter to ascertain the latter more precisely and to amend the calculations accordingly, with due regard to the improvements it is desired to effect. The general reasoning and method will, he thinks, be found correct, and, he hopes, of value to all who are interested in the design and performance of open-hearth furnaces. It is surely better to tackle the subject ab initio, with a clear view of the objects and underlying principles, than try to follow blindly the practice of others—British or foreign—who may, or may not, have "got there" by accident. Let us understand why, and possibly we may be able to improve thereon.

The metallurgy and practice folowed are, of course, equally important factors in any comparison of performances, but are outside the scope of this article, and must be reserved for a future paper.

A Review on the Use of Powdered Coal

Much Information Published Lacks Authority—Early Uses of Powdered Coal Reviewed—Author Discusses Different Methods Used Today—Comparative Data on Fuels—Charts Are Presented.

By **W. O. RENKIN,**

Much of the information and literature recently published on the subject of powdered coal has apparently been collected by those not conversant with the progress of the art or without investigation of the plants at present in operation or under construction.

The successful use of powdered coal has been known in connection with cement burning for nearly a decade, but its practical commercial use on metallurgical furnaces has only been worked out within a very few years. The plant of the American Iron & Steel Company at Lebanon, Pa., which was installed in 1905, can be considered the pioneer metallurgical installation. The benefits secured from this installation were of such moment and placed the American Iron & Steel Company so far in advance of its competitors, that it maintained a very discreet silence for several years. In fact, it was not until 1912 that the results were divulged. Then several other plants were undertaken and installed by men who had been associated with the pioneer work at Lebanon.

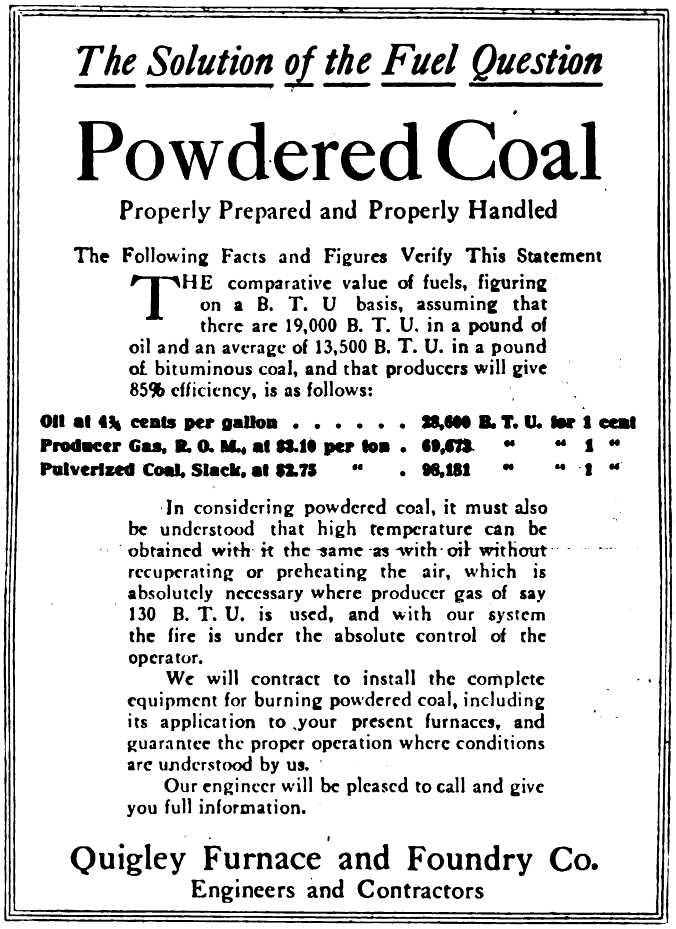
From the following advertisement which appeared in the November, 1912, trade journals, it can be seen that complete commercial powdered coal plants for metallurgical furnace work were offered then for the first time:

The use of powdered coal in metallurgical furnaces differs very broadly from its use in the manufacture of cement. In the cement industry an intimate mixture giving nearly perfect combustion and flame controlability are not essential, owing to the ash or cinder being carried over and combining with the cement clinker being burned. While in most metallurgical work it is not advisable to have the ash, or dust from the burning fuel carried over or deposited on the hearth, therefore, it was necessary to secure machinery and equipment which would, at the will of the operator, give variable control, both of the fuel mixture and its volume.

In many of the earlier installations, screw conveyors and bucket elevators were used to transport the powdered coal from the preparing plant to the various furnaces and as this method is not only expensive to install but costly to maintain and operate, even in the smaller installations while being impracticable for long lines, it was easily seen that some other method of transport must be devised to insure a more nearly universal use of pulverized coal.

In some installations a system of air flotation is employed in which the pulverized coal is stored in the preparing plant and then after mixing with 60 to 70 cubic feet of air per pound of coal is sent through pipes of large diameter as a gaseous mixture. Naturally the coal and air not actually needed by the various furnaces along the circuit is returned to the storage bin at the preparing plant and the coal is allowed to settle through dust collectors so as to be transported over again. This system at first sight would seem to be the ideal, but it has many disadvantages; not the least being danger from explosions and fires. There is also the practical impossibility of keeping the coal in suspension (i.e. floating in the air) at a sufficiently low velocity to economically burn in the furnaces with any degree of efficiency.

Owing to the high velocity of the fuel at point of combustion with this system, it is practically impos-



The Solution of the Fuel Question

Powdered Coal

Properly Prepared and Properly Handled

The Following Facts and Figures Verify This Statement

THE comparative value of fuels, figuring on a B. T. U basis, assuming that there are 19,000 B. T. U. in a pound of oil and an average of 13,500 B. T. U. in a pound of bituminous coal, and that producers will give 85% efficiency, is as follows:

Oil at 4¾ cents per gallon . . . . . . 28,600 B. T. U. for 1 cent
Producer Gas, R. O. M., at $3.10 per ton . 69,673 " " 1 "
Pulverized Coal, Slack, at $2.75 " . 96,181 " " 1 "

In considering powdered coal, it must also be understood that high temperature can be obtained with it the same as with oil without recuperating or preheating the air, which is absolutely necessary where producer gas of say 130 B. T. U. is used, and with our system the fire is under the absolute control of the operator.

We will contract to install the complete equipment for burning powdered coal, including its application to your present furnaces, and guarantee the proper operation where conditions are understood by us.

Our engineer will be pleased to call and give you full information.

Quigley Furnace and Foundry Co.
Engineers and Contractors

Fig. 1—Reproduction of first advertisement appearing on powdered coal.

Original from UNIVERSITY OF CHICAGO

sible to either eliminate the objectionable dust and smoke, or to properly control or regulate the amount of excess air which is being used. This very naturally wastes fuel.

Another disadvantage of the air flotation system is the inability to secure the high temperatures which are possible when the total air being supplied with the powdered fuel is under accurate control and regulation. As the volume of air necessary to carry the coal in suspension, amounting as it does to about one-half of the air required for perfect combustion, is moving at a very high velocity the stream of powdered coal and air is carried in a more or less solid core too far into the furnace, with the natural result of ash dropping on the hearth and in the flue or else being carried up the chimney and settling on the surrounding property.

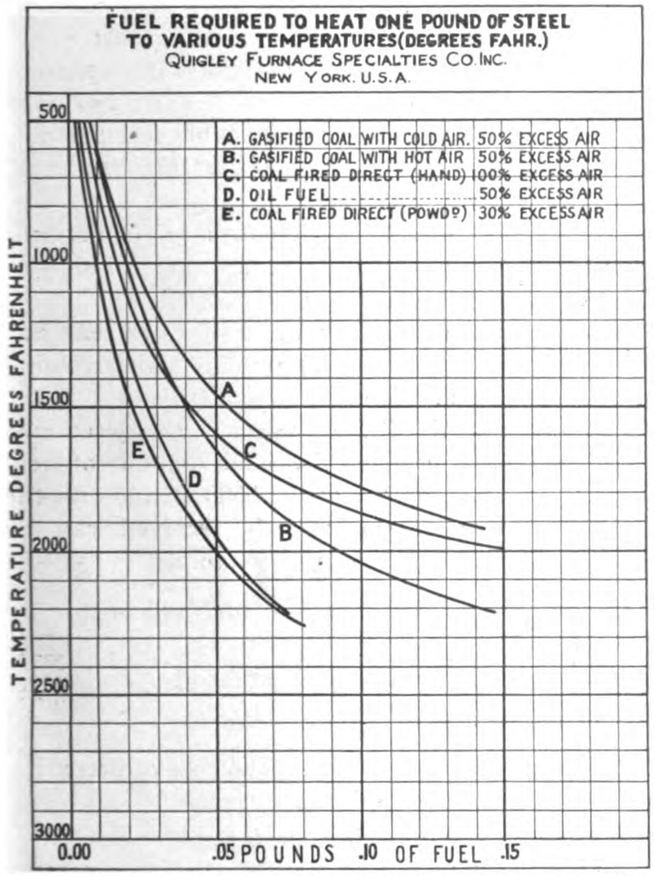


Fig. 2—Data sheet shows amount of fuel required to heat one pound of steel.

The regulation of the volume of oxygen supplied with any fuel is essential for economical results.

If too much air is supplied with the fuel, the amount of CO_2 formed does not replace the full amount of oxygen, consequently the fuel economy will be proportionately low. If insufficient air is supplied part of the carbon in the coal forms carbon monoxide. The heat units liberated for each pound of carbon burned to carbon monoxide will be only 4,500 or less than one-third of the full heat liberated when burned with the proper amount of air.

The quantity of excess air used in burning:

Powdered coal being	0 to 30 per cent
Producer gas being	50 per cent
Fuel oil being	10 to 50 per cent
Natural gas being	40 to 50 per cent
Hand fired coal being	100 per cent

It is evident that powdered coal gives the greatest heating efficiency.

In the more recent installations a system of transporting the coal through small wrought pipes from the preparing plant to the various departments or furnace bins by means of compressed air is installed and has been in successful operation for several years past.

This method seems to fill the need, as by it, the coal is handled rapidly (2,800 pounds having been transported 600 feet through a 4-inch pipe in one minute with an air pressure averaging 15 pounds gauge) and as safely as natural gas or oil.

By using the "Compressed Air Transport," the more recent installations have been able to economically place the coal preparing plant in relation to the coal supply. Then distribute the powdered coal to the various or possibly widely scattered departments, without waste of fuel and with the minimum expenditure of power.

In the most recent installations it is now possible to crush, elevate, dry, pulverize and transport the coal to the bins and feed it into the burners at the furnaces with absolutely no dust or leakage and without being touched by hand.

In installations using the compressed air transport system, the pulverized coal is fed into a cylindrically shaped blowing tank from which it is driven, not as a mixture but as pistons of coal alternating with pistons of compressed air. This is a novel feature which greatly reduces the amount of the air needed to transport the powdered coal. The average is, in properly designed apparatus, about 1½ to 2 pounds of coal to 1 cubic foot of free air when compressed to 30 pounds.

With this system, the coal is delivered by specially constructed switching valves into the individual or group furnace bins, through cyclone dust collectors. It is then drawn from the bottom of the furnace bin and fed in regulatable quantities into the low pressure syphon. From there it is carried by about one-seventh the volume of air necessary for combustion and delivered into the center of the burner where it is surrounded by and mixed with the proper quantity of very low pressure air (a mere breath) necessary for economical combustion at the same time secures the flame conditions which are desired. With this system the furnace operator has absolute and immediate control of the fuel and can secure any degree or condition of flame which is desired; the regulation of the fuel feed is as simple as turning the hand wheel of a natural gas valve.

A great deal of misinformation has been disseminated with reference to the dangers from the use of powdered coal fuel. Those installations which do not handle the coal as a gaseous mixture have been very greatly improved mechanically and now it can be authoritatively stated that powdered coal installations under such conditions do not affect the fire hazard of a plant.

The use of powdered coal fuel cover a very wide range and it is safe to say that any furnace which is now being hand-fired with coal can be quickly and successfully changed to powdered coal firing with greatly increased output and efficiency.

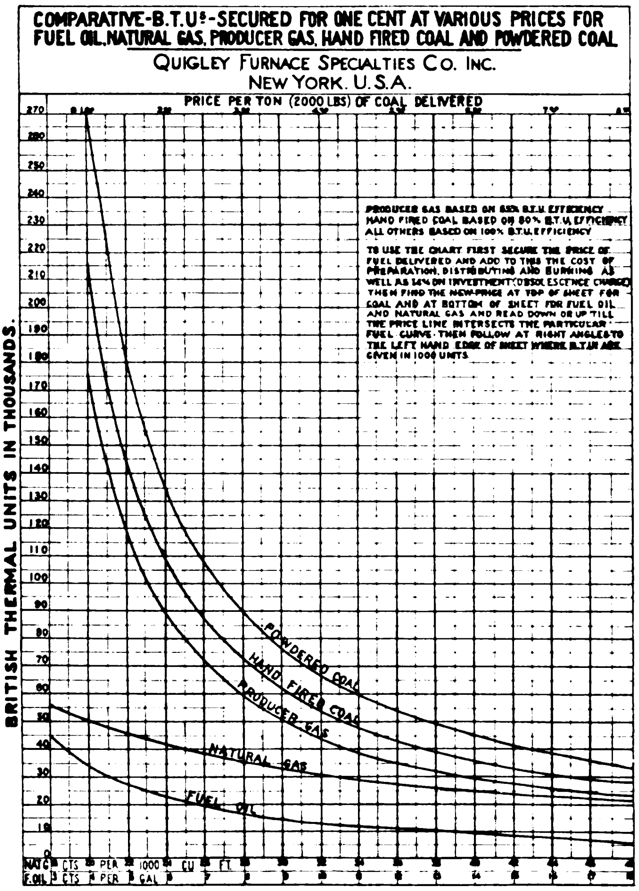


Fig. 3—Data sheet showing comparative value and advantage of different fuels.

Where furnaces are being fired with natural gas or fuel oil, some reconstruction work is necessary, but, in all cases the increased efficiency more than compensates for such changes.

To secure the maximum efficiency with powdered coal it is necesary to have properly designed furnaces. There are now engineers interested in the installation of powdered coal plants who are experienced furnace engineers and can, and will, furnish correct furnace designs along with the plans of the machinery and equipment for properly preparing, distributing and burning powdered coal. The plant owner can therefore, feel assured of immediate success from start in the burning as well as the preparing of the powdered coal.

Comparison of the Installation and Operating Costs of Producer Gas, Natural Gas and Hand-Fired Coal.

In some of the literature recently published, the authors ignore the present increased cost of labor and material due to war conditions. One author, for instance, states that the cost of preparing powdered coal is only 29 cents per ton. Upon a careful analysis of the records from which this figure was calculated, it was found that the basis for such a statement was labor at 15 cents per hour. The price of similar labor at the present time is 35 cents per hour.

As the number of powdered coal plants now in successful operation is very great, there does not need to be any approximation of the operating cost.

Let us, for a comparison, use the basis assumed by a recent contributor to *The Blast Furnace and Steel Plant*, viz.: Natural gas, 1,500,000 cubic feet per day, at 1,000 Btu per cubic foot=1,500,000,000 Btu at 10 per cent efficiency.

Assuming gas producers as operating at 65 per cent Btu efficiency to produce the same amount of heat would require 79 tons of coal (at 13,500 Btu.).

Assuming fuel oil as burning at 100 per cent Btu efficiency to produce the same amount of heat would require 11,110 gallons of oil (at 135,000 Btu.).

Assuming that the Btu efficiency of powdered coal is equal to gas to produce the same amount of heat would require 56 tons of coal (13,500 Btu.). As the average moisture in the coal is received can be assumed at 4 per cent, the figure is ample.

The comparative daily costs of fuel will be:

Natural gas, 1,500,000 cu. ft. at 35 cents	$525.00
Producer gas, 79 net tons coal at $3	237.00
Fuel oil, 11,110 gallons at 6 cents	666.60
Hand fired coal, 70 net tons at $3	210.00
Powdered coal, 56 net tons at $3	168.00

To these costs must be added the cost of preparing the fuel, including fixed charges.

Cost of installing equipment for

Burning fuel oil will be	$76,000.00
As given in the article above referred to	
In my opinion this should not be over	30,000.00
Producer gas will be	110,000.00
Powdered coal will be	70,000.00

Cost of operating will then be

Fuel oil plant, 14% on $30,000 per day	$14.00
Fuel oil per day	666.60
Labor, including foreman	72.20
Electric current and steam	6.00
Lubricating oil, waste, etc.	.75
	$759.55
Producer gas plant, 14% on $110,000 per day	$53.33
Coal, per day	237.00
Steam and water	3.00
Labor and supervision	29.00
Stores and supplies	1.12
Electric power	2.00
	$325.45

(Continued on page 119.)

Original from UNIVERSITY OF CHICAGO

Some Pointers on By-Product Coke Oven Operations

BY-PRODUCT COKE PLANT ENLARGED.

(Continued from Page 97)

the fire brick and the red brick closing the face of the regenerators. The pusher machines, which were built by the Wellman-Seaver-Morgan Company, are practically the same as on the original installation including the automatic reciprocating motion of the leveler. The cast steel end trucks are provided with counter-shaft bearings on both sides, so that the end trucks are interchangeable and but one spare need be carried for both trucks. The ovens, pusher wals, coal bin and concrete battery stacks are carried on Raymond concrete piles.

By-Product.

The original installation in the by-product building consisted of three positive type Connersville exhausters delivering through tar extractors and preheaters to three large oval type saturators, one unit being a spare. Two positive type Connersville boosters were provided for delivering surplus gas to the mills, one being a spare. The extension consists of a General Electric turbo exhauster, tar extractor, preheater and saturator and one General Electric turbo booster for a surplus gas. The gas is admitted to the continuous oval cracker pipe in the new saturator at both ends. This type of saturator was adopted in preference to the type originally built, in which the gas was all admitted at one end into two separate cracker pipes, one of which type has already been rebuilt.

The regulation of the gas in the collecting main is accomplished by governing with the turbo exhauster and Northwestern governors on the offtakes, the other exhausters being run at constant speed.

Two new primary coolers, a storage tank for weak liquors and an ammonia still were added.

The Youngstown Sheet & Tube Co., has installed a few labor-saving devices in connection with their by-product plant which are of interest. It designed and built a jib crane operating a one-half yard single line Brosius bucket for cleaning out accumulations in the hot drain and flushing tank. This bucket empties into a small dump car running on a narrow gauge track which delivers this material to a pit within reach of standard railroad track where it can be gathered by a locomotive crane. By this device men are never required to enter the hot drain or flushing tanks to clean out accumulations. An interesting feature of this tank which was designed by the company is the absolute and simple control of the proportions of tar and liquor for flushing purposes. The mix is ordinarily carried at 50 per cent each, but can be varied almost instantly by one valve to any desired proportion of tar and liquor. By means of this and other control features, the primary coolers which ordinarily have to be steamed out every few days, are run from four to six weeks at a time without being steamed out, which effects considerable saving of steam, labor and deterioration, due to expansion and contraction of the large number of tubes in these coolers.

In the sulphate storage room the company has designed and built a hopper, with a chute extending through the wall, whereby bulk shipments can be made by means of the overhead crane loading into the hopper and the salt running directly into the box car instead of having to wheel the salt out into the car by hand. In case bag shipments are to be made, the company built a loading hopper for this purpose. Sulphate of ammonia often cakes more or less while in storage and when loading into bags through the usual hopper, it is necessary to have a man on top of the hoppers pushing the salt down. By means of their special design of toothed rolls the salt is fed into the bags without any labor at the top.

Benzol Plant.

The original benzol plant was built by the Semet-Solvay Company, who also built the addition, which consists of two light oil stills and one refining still also auxiliary apparatus, wash oil coolers, gas coolers, gas cooler and has scrubbers. A new acid washer building was erected entirely separate from the main benzol building and so arranged that all apparatus can very readily be taken down and removed from the building for any repairs which might be dangerous in this location. Overhead hand operated traveling cranes are installed in both the main benzol building and the acid washer building. All new work rests on Raymond concrete piles as was the case with the original work. In constructing the additions particular care had to be exercised on account of the hazards of the industry. The concrete pile driver was furnished steam through a hose to avoid the use of the boiler. The wooden blocks under the hammer were renewed frequently and dropped into a barrel of water immediately after being removed, as at times they get so hot they burst into flame. All field work on the structural steel was bolted, no riveting being permitted on the site. The old wall of the main building was left intact except for a few bricks where the connections were made, until the new structural work was completely erected, walls bricked in, windows put in and roof put on, after which the wall was removed.

Boiler House.

One new B&W horsepower boiler was installed with Coxe traveling chain grate stokers, with which the entire boiler house is equipped and breeze produced at the coke plant is used for fuel. Gas burners are installed for emergency use only or for use Saturday night or Sunday in the case the surplus gas would otherwise be wasted.

Water.

The three Wheeler condensing and engineering forced draft cooling towers originally installed were made large enough to take care of the extension.

REMARKABLE FEAT IN FAST COKING.

The United Furnace, of Canton, Ohio, due to the coke shortage during the war period, have just completed a period of fast coking, which is thought to have not been equalled in the United States or foreign countries with an 18-inch or wider oven.

This period was of one year and nine months duration, in which time the minimum coking time was 15 hours and the maximum 15 hours and 20 minutes. At the end of this period, due to constant watching and supervision, it was found that neither oven walls or heating flues showed any signs of fluxing.

The loss of by-products due to high temperature carried, were less than would be expected, this plant ranking one, two, in Toluol production per oven in the United States.

The United Furnace Company operates ovens of the Koppers type, 18¼ inches wide and of 12.25 ton capacity.

INDUSTRIAL RELATIONS

STEEL PLANT INDUSTRIAL RELATIONS.

(Continued from page 104.)

consideration i nexchange for a job, better working place or any advantage in working condition.

c. Stealing or malicious mischief, such as destroying or hiding any property of other employe or of the company.

d. Inhuman abuse of live stock or negligence resulting in their death.

2. Violation of the following safety rules:

a. Careless in regard to accident and safety of fellow workmen.

b. Riding on standard or narrow gauge equipment or on any moving machinery where not assigned.

c. Running up blocks on cranes.

d. Violation of rules governing repairing or oiling of moving machinery.

e. Failure to wear safety goggles that have been provided.

f. Smoking within prescribed limits or other places where such practice is forbidden.

3. Insubordination (including refusal or failure to perform work assigned) or use of profane or abusive language toward fellow employes or officials of the company.

4. Absence from duty without notice to and permission from superintendent or foreman, except in case of sickness or cause beyond his control of a character that prevented his giving notice.

5. Harboring disease that on account of his own carelessness will endanger fellow workmen.

6. Changing working place without orders or prowling around the works from assigned place.

7. Falsifying or refusing to give testimony when accidents are being investigated, or for false statements when application and physical examination is is being made.

8. Neglect or carelessness resulting in damage to railroad equipment, or neglect of car dropper to properly set brakes on railroad cars in his charge.

9. Robbing railroad or narrow gauge car journal boxes of waste.

10. Wilful neglect in care or use of company's property.

Procedure for Adjustments.

1. Any matter which in the opinion of any employe requires adjustment, and which such employe has been unable to adjust with the foreman of the work on which he is engaged, and any matter deemed proper to be submitted by any committee, may, in the case of such employe, be taken, up, either in person or through any representative of his division, or in the case of a committee, may be taken up by the committee with the following named persons, and in the order named:

First—The superintendent of the department to which the division belongs.

Second—The management's representative.

Third—The superior operating officers of the company, who shall endeavor to effect a settlement, or who may with the approval of the employe, or representative, or committee, submitting the proposition, refer the same to any joint committee.

2. Where a satisfactory disposition of any such matter has not been effected within a reasonable time, the employe, through his representative, or the committee, or the management, through the management's representative, may require such matter to be referred to the joint general committee on appeals, by a request in writing addressed to said committee, specifying in detail the matter requiring adjustment and the reasons which warrant its consideration by said committee.

The joint general committee on appeals shall consider any such matter with reasonable promptness at a regular or special meeting, and may adopt such means as are necessary to ascertain the facts and effect a settlement.

3. If the joint general committee on appeals fails to effect a satisfactory settlement, the matter shall be referred to the president of the company. If the president of the company and a majority of the employes' representatives on the joint general committee on appeals fail to effect a satisfactory settlement, they shall refer the matter to arbitration as they may determine at the time, according to the nature of the controversy.

If the president and a majority of the employes' representatives on the joint general committee on appeals are unable to agree upon an arbitrator, or arbitrators, the president shall select one arbitrator, and the employes' representatives on the joint general committee on appeals shall select one arbitrator; and the two arbitrators thus selected shall endeavor to settle the matter in dispute.

If the two arbitrators are unable to settle the matter in dispute, they shall select a third arbitrator. If they cannot agree upon a third arbitrator, the third arbitrator shall be selected by the presiding judge of the District Court of the United States for the Northern District of Ohio, Eastern division; and the decision of any two of the three arbitrators thus chosen shall be final and binding on both parties.

Independence of Employes' Representatives.

1. It is understood and agreed that a representative shall be free to discharge his duties in an independent manner without fear that his individual relations with the company may be affected in the least degree by any action taken by him in good faith in his representative capacity.

2. To insure to each representative his right to such independent action, he shall have the right to take the question of an alleged personal discrimination against him on account of his acts in his representative capacity, to the management's representative, to any of the superior operating officers, to the joint general committee, and to the president of the company.

3. Having exercised this right in the consecutive order indicated, and failing a satisfactory remedy within 15 days, a representative shall have, for the ensuing 15 days, the further right of appeal to the Secretary of Labor of the United States. The company shall furnish the Secretary of Labor with every facility for the determination of the facts; and, as respects any representative deemed by the Secretary of Labor to have been unfairly dealt with, the company shall make such reparation as the Secretary of Labor may deem just.

Amendments.

Any method of procedure hereunder may be amended at any time by a two-thirds vote of the entire membership of the joint general committee and the joint committee on rules, or by a majority vote of the employes' representatives present and a majority vote of the representatives of the management present at an annual conference.

PRODUCTION TOPICS

NATIONAL SLAG ASSOCIATION MEETING.

At a meeting held January 10, at the offices of the National Slag Association, at 933 Leader-News Building, Cleveland, Ohio, the directors of that organization elected the following officers for the year 1919: F. A. Sarstedt, president; C. E. Ireland, vice president; H. J. Love, secretary-treasurer.

The executive committee chosen for the same time will be composed of the following: F. A. Sarstedt, L. A. Beeghley, L. H. Hawblitz, E. H. Kuttner, C. L. McKenzie.

In all about eighty (80%) per cent of the commercialized blast furnace slag tonnage of the country is represented by this association, whose aim is ultimate standardization of this product when used as railroad ballast, concrete aggregate, or macadam highway construction.

The executive committee was authorized to act as a contact or coöperation committee with similar committees appointed by the national organizations, which are supported by the sand, gravel, and stone interests in the United States.

BRIQUETTING DEMONSTRATION PLANT.

The General Briquetting Company, 25 Broad street, New York City, is installing its new demonstration and custom briquetting plant at Fifty-seventh street and Twelfth avenue, New York City.

This plant is designed to demonstrate on a commercial scale, modern methods of briquetting metal, coal, flue dust, concentrates, and other fine materials. The installation includes a "Type A" 325-ton hydraulic metal briquetting press, adaptable to steel, brass, aluminum or other metal scrap; Belgian roll coal briquetting machinery; rotary toggle press, masticators, annealing ovens, dryers, elevator and conveyor system and power plant. It will commence operations about February 1, 1919. Cost, $200,000.

H. K. Schoch, chemist, late of the National Bureau of Standards, Washington, D. C., and George R. Cowan, briquetting engineer, late of Ellington Field, Texas, have resumed their positions with the General Briquetting Company, 25 Broad street, New York City.

COGNE IRON MINES, ITALY.

A recent issue of "Industrie Italiane Illustrate" describes the proposed development of the well-known Cogne iron mines. The Valle d'Aosta has copper, anthracite, and iron mines, from which, until a few years ago, was obtained the Valle d'Aosta iron, which, for quality and purity, was considered equal to the best Swedish iron. Hydro-electric plants are already working at Montjevet and at St. Marcel for the production of electric energy and of carbide of calcium; at Donnaz and at Pont St. Martin for the electrolytic production of copper; at Thuile for the extraction of anthracite; at Verres for iron pyrites; at Villeneuve for the production of aluminium. On the river Lye a plant of 50,000 hp is being constructed, and other plants which will furnish altogether about 200,000 hp for the Ansaldo firm of Genoa. The most important among these is the electric-furnace plant of the last-named firm. The iron ore will be extracted from the Cogne mines and smelted in eight electric furnaces in Aosta. Other eight electric furnaces of 15 tons capacity will turn the pig iron into steel, to be rolled into plates, which, before the war, were almost a German monopoly. The ore is magnetite, containing from 50 to 66 per cent of iron, and in certain veins up to 68 and 70 per cent. The ore is free from phosphorus, and contains only small traces of sulphur. There are about 10,000,000 tons of ore existing in these mines. It is estimated that about 200,000 hp are required for smelting, transport, etc. Two of the plants are almost finished, that of Aymeville of 10,000 hp, and those near Cogne of 3,000 hp. A rolling mill is being installed, also plants for the production of ferro-chrome, ferro-vanadium, ferro-tungsten, etc.; also foundries for special castings of both iron and of steel, and a factory for making electrodes.

SUPPLEMENTING PLATE MILL DATA.

Inadvertently some information was omitted in the January issue of THE BLAST FURNACE AND STEEL PLANT which will be of interest to the readers. On page 43 of that issue an article appeared relative to the new 84-inch and 132-inch plate mills of the Brier Hill Steel Company. To this article we wish to add that both of these mills were built by the United Engineering and Foundry Company, of Pittsburgh, Pa., and are driven by Westinghouse motors. A detailed description of these motors appeared on page 46. The 30-inch Universal Mill of the Mark Manufacturing Company, described on page 56, was built by the Mackintosh, Hemphill Company, of Pittsburgh, and is driven by a Westinghouse reversing motor. It is noteworthy that this mill rolled 17,387 tons of plates, 80 per cent of which were 5/16-inch or less, during the month of October. Further illustrations of this mill and drive are shown on page 35 of the same issue in an article written by Brent Wiley, Manager Mill Section, Industrial Department, Westinghouse Electric and Manufacturing Company.

A REVIEW ON THE USE OF POWDERED COAL.

(Continued from page 116.)

Powdered coal plant, 14% on $70,000 per day	$ 32.66
Coal per day	168.00
Unloading cost per day	1.08
Electric current	14.58
Supplies, etc	1.62
Fuel for drying coal	3.22
Labor	16.80
	$237.96

The comparison then becomes:

Natural gas per day	$525.00
Fuel oil per day	694.55
Producer gas per day	328.75
Powdered coal per day	237.96

Assuming that a plant operates 300 days per year, the saving by using powdered coal fuel over the other fuels would be:

Powdered coal over natural gas....$86,112.00 saving per year
Powdered coal over fuel oil......136,977.00 saving per year
Powdered coal over producer gas.. 27,237.00 saving per year

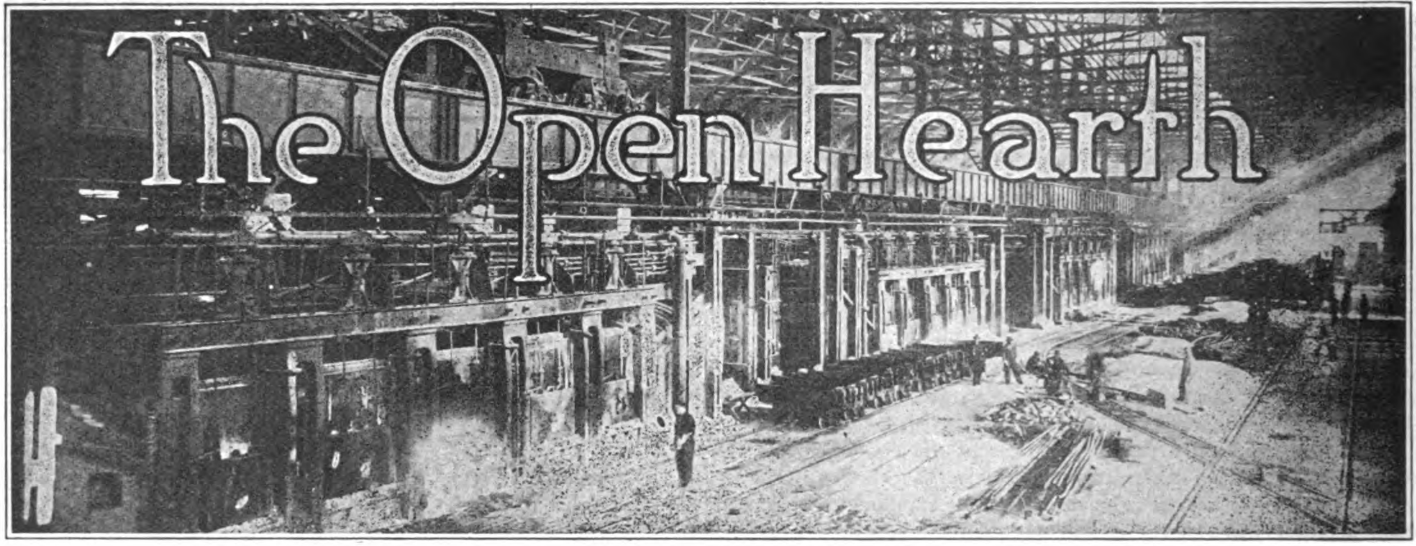
The figures here given are all based on 1918 prices of both labor and material.

The British thermal units which are procured for 1 cent on the basis of the operating costs given in this article as shown by the heavy dots on chart shown on previous page are:

Fuel oil	21,596 Btu
Natural gas	28,571 Btu
Producer gas	45,627 Btu
Powdered coal	63,035 Btu

Therefore, from operating point of view, powdered coal is at least 38 per cent better than producer gas; and 120 per cent better than natural gas.

Original from UNIVERSITY OF CHICAGO



The Open Hearth

At the meeting of the board of directors of the American Iron and Steel Institute, held on Friday, January 17, the resignation of Maj. Powell Stackhouse of Philadelphia, as a member of the board, was accepted and Charles H. McCullough, Jr., the new president of the Lackawanna Steel Company, was elected a director to succeed Maj. Stackhouse.

It was decided to have the usual general meeting of the Institute in New York City in May, and the committee on arrangements, which has served so long, consisting of Messrs. James A. Farrell, James A. Burden, E. A. S. Clarke, Charles M. Schwab and John A. Topping, was reappointed to serve as the committee on arrangements for this meeting.

The following were elected to active membership in the institute: Orrin H. Baker, salesman; Illinois Steel Company, Chicago, Ill.; William T. Burt, auditor, La Belle Iron Works, Steubenville, O.; Harry Kennedy, superintendent blast furnaces, Donner Steel Company, Buffalo, N. Y.; Willis F. McCook, president Pittsburgh Steel Products Company, Pittsburgh, Pa.; Duncan B. Palmer, superintendent Blooming and Bar Mills, La Belle Iron Works, Steubenville, O.; Philip M. Guba, manager sales, Donner Steel Company, New York City.

The following were elected to associate membership in the institute: Nathan H. Gellert, president Gellert Engineering Company, Philadelphia, Pa.; Howard R. Kiroock, presilent Hudson Sheet & Tin Plate Co., New York; Thomas W. Pangborn, president and treasurer Pangborn Corporation, Hagerstown, Md.; Albert H. Hudson, purchasing agent American International Steel Corporation, New York.

* * *

Robert M. Hutchinson, formerly blast furnace foreman, has been appointed assistant superintendent of the blast furnaces of the Bethlehem Steel Company at Sparrows Point, Md.

* * *

Paul R. Molding has been appointed blast furnace foreman of the Bethlehem Steel Company furnaces at Sparrows Point, Md.

* * *

William Bangser is now superintendent of the steel treatment department of the Bethlehem Steel Company at Sparrows Point, Md.

* * *

Lewis D. McClain, formerly metallurgist and chief of steel production and inspection for the United States Navy Department, has resigned, to become associated with Rogers, Brown & Co.

J. Leonard Replogle has been elected a director and chairman of the board of the Wharton Steel Company, Dover, N. J.

* * *

F. E. Norris, formerly superintendent of the Sharon plants of the Carnegie Steel Company, has returned from France, where he has been in charge of the erection of a steel plant at Lyons. After placing contracts for materials he will return to France.

* * *

Lieut. George C. Varnum, formerly assistant superintendent of the Commonwealth Steel Company, St. Louis, Mo., has returned to his former position, after having had charge of a machine gun company.

* * *

R. Netzebaud has charge of the safety department of the National Enameling and Stamping Company, Granite City, Ill.

* * *

J. M. Jones, manager of the sheet and tin plate department of the Bethlehem Steel Company, has resigned his position to take up other important duties.

* * *

M. C. Spencer is now in charge of metallurgical operations at the Electric Steel Company of Indiana, Indianapolis. Mr. Spencer was formerly connected with the Midvale Steel Company, and with the Watertown arsenal as chief chemist.

* * *

M. C. Turpin has again returned to the Westinghouse Electric and Manufacturing Company at East Pittsburgh, to take up his former duties in the publicity department. He was in the Ordnance Department for some time, but later went to the officers training camp at Camp Humphreys and then to Camp Kendrick, N. J.

* * *

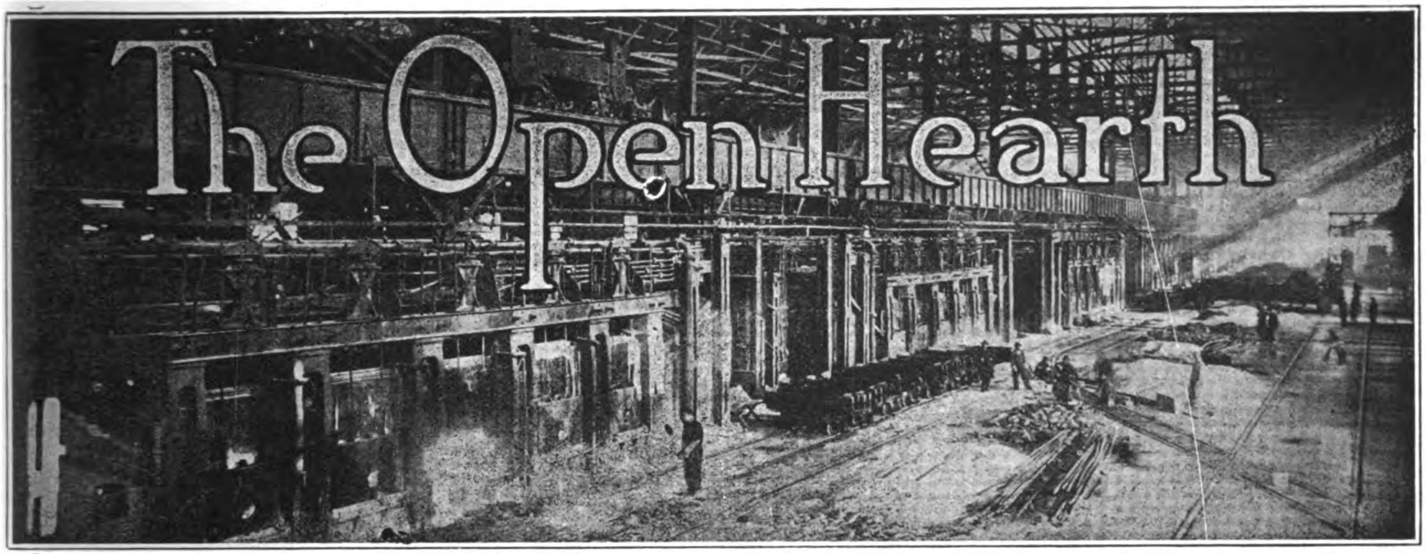
Capt. de Coursey Brown, formerly metallurgical engineer for the Metal and Thermit Corporation, and later in the Ordnance Department, has returned from France. He will be located at the Engineers Club, 32 W. Fortieth street, New York.

* * *

Harry Wright, after a seven month's business trip in South America, has returned. Mr. Wright is president of the Consolidated Rolling Mills & Foundries Co., 25 Broad street, New York.

* * *

H. F. Devens has resigned as vice president of the Superior Steel Corporation.



Frank Purnell, associated with the Youngstown Sheet and Tube Company for 15 years, is now connected with the Consolidated Steel Corporation, New York.

V V

A. C. Ryan has resigned his position as manager of the Cromwell Steel Company, Lorain, O., to take up private interests in Cleveland.

V V

Lieut. Richard K. Durkan, formerly manager of the Warren Steel Castings Company, St. Louis, who was wounded in France, has recovered.

V V

R. A. Byrns, first lieutenant in the United States infantry, has returned from France. He was wounded in severe action during the month of September. After resting he will again resume his duties as New York sales manager of the Northern Engineering Works.

V V

T. H. Mathias, formerly assistant general superintendent of the Buffalo plant of the Lackawanna Steel Company, has been appointed general superintendent. O. W. Whitehead succeeds Mr. Mathias as assistant general superintendent.

V V

O. F. Downs has been made a vice president, in charge of operations of the Lackawanna Steel Company, at Buffalo. He was formerly general superintendent.

V V

John Wheeldon, recently connected with the Elyria Iron and Steel Company, Cleveland, has returned to Worcester, Mass., to become associated with the Spencer Wire Company. Mr. Wheeldon was connected with the American Steel and Wire Company for over 25 years.

V V

William H. Eshelman, formerly superintendent of the 72-inch plate mill of the Sharon Steel Hoop Company, succeeds Frank Pyle as superintendent of the plate mill of the Brier Hill Steel Company, Youngstown, O. Frank C. Walker succeeds Mr. Eshelman at the Sharon Steel Hoop Company.

V V

H. S. Stockdale has again resumed his position as Pittsburgh representative of the Terry Steam Turbine Company, and the Spray Engineering Company.

V V

W. H. Vodrey is now secretary-treasurer and general manager of the National Drawn Steel Company, East Liverpool, O.

W. F. Singer, formerly assistant manager of the tin plate department on the Winton Steel Company, at Winton, W. Va., has been made assistant to the third vice president of this company.

V V

Jerome R. George, chief engineer of the Morgan Construction Company, Worcester, Mass., and Paul B. Morgan, president and treasurer of that company, have sailed on a business trip to Europe.

V V

Samuel E. Hackett has been appointed manager of sales for the Jones & Laughlin Steel Co., Pittsburgh, Pa.

V V

A. N. Richardson, formerly connected with the National Drawn Steel Company, East Liverpool, O., is now assistant to the president of the Miner Morse Steel Company, Erie, Pa.

V V

Daniel T. Haddock, superintendent of the Farrell, Pa., plant of the American Sheet and Tinplate, has been elected president of the Sharon Chamber of Commerce.

V V

W. C. Fletcher resigned as manager of the American Steel Foundries plant at Sharon, Pa. He is succeeded by A. Robertson.

V V

William S. Rogers has been admitted to the firm of Rogers, Brown & Co. Mr. Rogers is the son of William A. Rogers, senior partner and founder.

V V

A. S. Mather, has been admitted to the firm of Pickands, Mather & Co. He is the son of Samuel Mather.

V V

Henry Butler, Youngstown, Ohio, formerly in charge of the cost department of the Youngstown Sheet and Tube, is now in charge of the home service section of the Home and Hospital Bureau, American Red Cross, in Paris, with the commission of captain.

V V

Floyd Rose, who for some time was connected with the Carbon Steel Company and also with the Portsmouth Steel Company, Portsmouth, Ohio, has been appointed secretary of the Heppenstall Forge and Knife Company, Pittsburgh.

V V

L. H. Ralph is now vice president of the H. H. Trimble Steel Company, Pittsburgh, Pa. Mr. Ralph was formerly assistant secretary and assistant treasurer, Ordnance Department, United States Steel Corporation.

FOREIGN RELATIONS

CONSOLIDATED STEEL CORPORATION.

The organization formed by the independent steel manufacturers to handle their export trade has been incorporated in the State of Delaware with a capital of $10,000,000. Active business was started on January 2, with the opening of general offices in the City Investing Building, New York.

The Consolidated Steel Corporation, which is the name finally adopted, will be the exclusive agency for exporting the merchant iron and steel products of the following companies: Bethlehem Steel Company, the Brier Hill Steel Company, Cambria Steel Company, Lackawanna Steel Company, Republic Iron and Steel Company, Sharon Steel Hoop Company, the Trumbull Steel Company, Whitaker-Glessner Company and the Youngstown Sheet and Tube Company.

Together these companies control more than one quarter of the steel making capacity of the country and their annual ingot capacity is about 12,000,000 tons. It is expected that other companies will join, until substantially all important steel producers of the country, outside of the United States Steel Corporation, will be represented.

The president of the organization is E. A. S. Clarke, who resigned from presidency and directorship of the Lackawanna Steel Company in order to devote his full time to the new enterprise. H. H. Barbour, the vice president, was formerly with the Lackawanna Steel Company, and the same is true of L. W. Hesselman, secretary and comptroller, and A. Van Winkle, treasurer. Mr. Hesselman was comptroller of the Lackawanna company, and Mr. Van Winkle was secretary to Mr. Clarke, when he was at the head of that concern. The traffic manager is William Heyman, formerly foreign freight agent for the Delaware, Lackawanna and Western Railroad.

The board of directors consists of the heads of the constituent companies.

Foreign offices are to be opened and representatives appointed to cover every part of the world where American iron and steel products are usable.

The launching of this company, the first among the steel producers to avail, under the Webb bill, of the right to combine and coöperate in export trade, marks the beginning of a broad constructive work. This will benefit not only those directly interested, but the whole country, and should receive the hearty support of all who believe in the value to the United States of an increasing foreign trade in manufactured articles.

FRENCH IRON AND STEEL CONSORTIUM.

According to a cablegram of January 16, 1919, from the clerk to the American commercial attaché at Paris, the French Ministry of Industrial Reconstruction has announced that the control of the iron and steel consortium over imports was withdrawn from January 2, 1919, and stocks on hand are being liquidated. The consortium will continue to exist solely for the liquidation of stocks of iron and steel now held in various parts of France. Hereafter applications for license to import iron and steel should be addressed direct to the Minister of Industrial Reconstruction, Raw Materials Section, Bureau of Importations. Refusal or approval of applications for licenses will be given within a period of three days. It is understood that American firms and their affiliations will be given the same consideration in the matter of granting licenses as is given French firms.

COMMERCE REPORT.

The following items appeared in the daily report of the Bureau of Foreign and Domestic Commerce, Washington, D. C. Further information can be secured from the bureau.

A man in Italy desires to secure an agency for the sale of industrial and agricultural machinery, iron, steel, and other products of the mining industry. Correspondence should be in French or Italian. Catalogs should be submitted. References.

A firm in Norway desires to secure an agency and to purchase steel plates, black; steel wire, black and galvanized; leather belting; traveling bags and necessities; rugs; linoleum; electric stoves; electrical supplies; groceries of all kinds; and tobacco. Correspondence may be in English. Reference.

A firm in Algeria desires to purchase and secure an agency for the sale of anthracite and bituminous coal in quantities of 5 or 10 tons at a time. This firm is also interested in iron and other metal products and hardware. Terms, payment against documents. Correspondence should be in French. References.

MARKET FOR AMERICAN STEEL AND IRON PRODUCTS IN CARDENAS.

Consular Assistant George A. Makinson, Cardenas, Cuba.

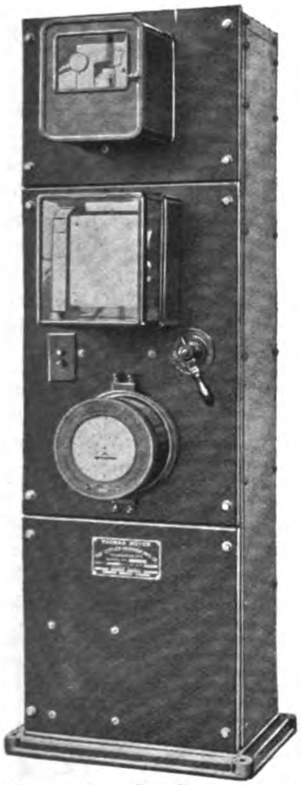
Cardenas, with a population of 32,000 inhabitants, is rated as one of the chief industrial center of Cuba, and offers a favorable market for the sale of American iron and steel products, such as rails, plates, bars, angles, and galvanized sheeting. Three large machine shops and foundries located here employ approximately 500 skilled mechanics. These concerns specialize in the manufacture of boilers, tanks, conveyors, and other machinery used in the various sugar mills scattered throughout this consular district. There is also a recently established factory devoted to the construction of freight cars and similar railroad equipment. The "United Railways of Habana (Ltd.)" maintains an important repair shop and construction staff in this city and uses considerable steel for bridges and new trackage. Purchases for this undertaking are made through the company's chief purchasing agent, located in Habana.

In addition to the above users, there are a number of local hardware houses which keep on hand considerable stocks of steel bars and plates as well as galvanized sheeting. While these houses supply the usual city demands, the great bulk of their business is derived through order received from the interior sugar estates. Although there is considerable new construction under way in Cardenas, these structures, as a rule, are neither very high nor very large, and as they are generally built of brick with tile roofs, the need for reinforcing bars and iron sheeting should not be overestimated.

In the past it has not been customary for local users and dealers to order direct from the mills. Several prominent American manufacturers maintain branch offices or resident agents in Habana, and it is through such channels that local orders are customarily placed. Although all of the resident industrial concerns have been working to full capacity for months and stocks are extraordinarily low, the impression prevails that large orders for raw materials will be deferred until next spring.

WITH THE EQUIPMENT MANUFACTURERS

NEW DESIGN OF INSTRUMENT PANEL USED WITH ELECTRIC GAS METER.



New A. C. Instrument Panel for Thomas Meter.

An improved design of instrument panel for use with the Thomas meter has just been completed by the Cutler-Hammer Manufacturing Company of Milwaukee. The earlier panels carried both the recording instruments and the regulating apparatus and in order to make possible their installation in different locations the company has now mounted the instruments on a separate small panel. The total and graphic records of the gas flow can therefore be placed, with a minimum of space requirement, in the coke oven or open-hearth superintendent's office, or near the operator's, and the regulator can be located convenient for inspection by electrical maintenance men. The meter housing is of course located at a point in the pipe line where a measure of the gas flow is desirable. In accordance with the modern trend of safety ideas, further refinements have also been made in the design of the instrument panel to make it practically fool proof and shock proof. The new design follows the dead front principle of switchboard construction, as the accompanying illustration shows. The top section contains the galvanometer which differs from the usual form of laboratory instruments in that the number of sensitive parts has been reduced to a minimum, and those sensitive parts that are necessary are made easily replacable, while all other parts are made very strong and durable. The mechanism and connections are placed in an aluminum case and are arranged so that the sensitive parts are well protected but accessible. It is constructed jointly by the Leeds & Northrup Co., and the Cutler-Hammer Company. Most forms of galvanometer are placed in wooden cases and are so constructed that they do not give good service when used by unskilled mechanics.

The middle section contains the Easterline graphic watt meter which records in standard units the flow of gas through the meter housing. Below the Easterline instrument is a Westinghouse single-phase watt meter, with scale calibrated for thousands of cubic feet of gas, which shows the total gas flow. Mounted on the back of the center section is a square D quick knife switch, operated by a lever on the front of the section, which serves as a main line switch for the heater circuit and all control circuits. At the left of this switch is mounted a push button control switch which operates a C-H single pole remote control switch. This switch is magnetically opened and closed and mechanically locked and is used to open the heater circuit in the meter housing to permit the operator to balance the meter. The instrument panel also contains a current transformer, for all except the small sizes of meters, and fuses for the recording circuits and test connections for electrically testing the two watt meters. These wattmeters are standard 5 ampere 110 or 220 volt instruments, hence they may be tested for accuracy in the same manner as any other standard indicating or integrating electrical instrument, that is, by connecting them in series with similar meters of known accuracy. Test constants are stamped on each meter and it is not necessary to shut off the gas or interrupt the gas measurement to test the recording and integrating instruments. All live parts are enclosed in the enclosing case upon which the sections of the panel are mounted and the complete panel is furnished with a cast-iron sub-base necessitating no other work in installation than the mere lagging of the base to the floor.

QUICK-MAKE STARTING SWITCH.

One of the new equipments brought out by the Westinghouse Electric and Manufacturing Company during the past year is an interesting starting switch. The switch is designed for use where squirrel-cage motors are started with a full line voltage. The switch is known as the Quick-Make (and quick-break) starting switch (Type 816). Its characteristics are 10 to 100 amperes, 25 hp maximum, three-phase, 220, 440, and 550 volts.

This switch is extremely flexible in its applications; in addition to being a motor starting switch it can also be used to control feeder circuits; it may be supplied in any of the following combinations, each having the "quick-make and quick-break" feature, for either hand or shipper-rod operation:

a. Non-automatic switch.
b. Switch with low-voltage protection.
c. Switch with inverse time element overload protection.
d. Full automatic switch with low-voltage and inverse time element overload protection.

It is especially suitable for shipper-rod operation on account of the positive action of the contacts. It is impossible for the operator to retard the motion of the contacts after they have started to close; there can be no "teasing" of the contacts. Workmen who are accustomed to starting machines from line shafting by means of shifting belts have no confusing details to learn. They may start the motor-driven machine with the same starting motion they use in shifting belts.

Contacts are opened and closed in oil, thus effectually suppressing arcing. The contact is made or broken so quickly that the eye cannot follow the motion. A rolling action confines the arc to the tips of the contacts and prevents pitting or roughening of the seating parts where final contact is made. A strong spring holds the contacts firmly in the closed position. These features result in greatly prolonged life for the contacts.

Construction—Drawn-steel construction is used, giving maximum strength with light weight, and assuring uniformity and interchangeability when new parts are needed for replacement or repairs. The oil tank is supported by snap ring-latches. Removal of the tank clearly exposes the contacts and makes them easily accessible. When necessary to replace contacts each may be removed by taking out a single screw.

NEWS OF THE PLANTS

The Bethlehem Steel Company, Bethlehem, Pa., will complete the new additions to its steel works at Sparrows Point, Md., now under way, more than doubling the capacity of the plant. Present construction work includes the erection of a 40-inch blooming mill in combination with 18-inch and 24-inch continuous mills; 60-inch universal plate mill; continuous reheating furnace for roll mill; and two 5-ton blast furnaces. The first of four batteries of 60 coke ovens has now been completed and placed in operation, and it is expected to complete the remaining batteries by summer of the present year. Each battery is costing about $1,500,000 and will require approximately 30,000 tons of coal per month for operation. Beyond the general works extensions, new ore docks are now being constructed to facilitate the handling of materials, while a housing development is well under way, including about 70 homes for workers at the mills. About $35,000,000 has been expended to date in this expansion work out of an appropriation of $50,000,000. Approximately 15,000 men are now being employed and it is understood that with the completion of the new extensions this number will be increased. W. F. Roberts is general manager.

The Central Iron & Steel Company, Harrisburg, Pa., will make general repairs and improvements at its local steel works. During the war period activities at the works precluded necessary work of this nature and it is planned to shut down the individual units for this purpose in regular sequence until the operations are concluded. The universal mill has suspended work for this purpose and following general betterments as arranged, other departments, including Mill No. 1 and 2, open-hearth works and blast furnace will be given attention.

The Wayne Steel Company, Erie, Pa., affiliated with the United States Horse Shoe Company of the same city, has arranged for the immediate erection of a new steel works, on property adjoining the plant of the associated interest. The initial works will consist of two 25-ton open-hearth furnaces, a number of gas producers, charging apparatus and other equipment for the manufacture of ingots, to be used in part by the United States Horse Shoe Company. The main open-hearth building will be about 125x300 feet.

The Wharton Steel Company, Wharton, N. J., recently closed down its three blast furnaces, including the unit working on manganese. It is understood that this latter furnace will not again be placed in operation until the market for this material improves. The second furnace was closed down through lack of ore, while the third was forced to suspend through breakage in hoisting machinery. This latter unit is expected to be in operation again at an early date. The company also operates iron ore properties including the section known as Scrub Oak and the new works, recently completed at Mine Hill. The Wharton railroad, controlled by the company, operates between the mines and the blast furnaces. The company is now giving employment to about 200 men at its furnaces, having cut down its recent working force of about 450 to this number.

The Donner Steel Company, Abbott Road, Buffalo, N. Y., has inaugurated extensive expansion work at its plant for increased capacity. In addition to recent extensions covering a new plate mill and other structures, plans have been completed for a one-story addition to the open-hearth department, about 80x150 feet, to cost $12,000, a second one-story addition, about 85x500 feet, to cost $45,000, and another one-story structure for general works purposes, about 30x200 feet, to cost $15,000, making a total of $72,000 for this work. The company recently increased its capital from $11,000,000 to $13,000,000 for general expansion purposes and has now arranged for a new preferred stock issue of $3,000,000 for existing needs. The Donner-Union Coke Company, an affiliated organization, has also arranged for the construction of a number of additions to its works to represent in aggregate about $375,000. These structures will include a by-product building to cost $100,000, benzol works, boiler plant, machine shop and a number of other structures.

The Onondaga Steel Company, East Water street, Syracuse, N. Y., with works at Massena Springs, is planning for the construction of a number of additions to its plant during the coming spring for increased capacity. Additional property in this section has recently been acquired for the proposed expansion. The company specializes in the production of bar iron under a special process. E. E. Newkirk is secretary.

The Wisconsin Steel Works, Torrence street, Chicago, Ill., will build a number of additions to its plant for increased capacity. The work will include a battery of new coke ovens to cost in excess of $2,000,000, and general works buildings to cost about $50,000.

The Canton Sheet Steel Company, Canton, O., is planning to increase the capacity of its plant during the coming year. It is proposed to replace two 30-ton furnaces with two units of improved type of 90 tons capacity each, increasing the rated output by about 150,000 tons. It is also planned to inaugurate construction work on an 18-inch bar mill at an early date to enlarge the output in this department of the works.

The American Sheet & Tin Plate Company has resumed operations at its Old Meadow Mill, Scottdale, Pa., and plans to operate the plant at capacity. The works will give employment to about 450 men.

The Crucible Steel Company of America, Pittsburgh, Pa., has awarded a number of miscellaneous contracts for the completion of a new one-story rolling mill at its Harrison, N. J., plant. The structure will be located on Fourth street; it will be 200x400 feet, and is estimated to cost $375,000. The company is also building an extension to its open-hearth plant at the works, to include a department for electric furnace operation, as well as an extension to the annealing plant. These latter structures were commenced some time ago, and it is understood that active work will proceed to insure completion at an early date.

The Virginia Coal, Iron & Railroad Co., Roanoke, Va., is planning for improvements in its blast furnace at Graham. The plant will be operated for the production of pig iron and it is understood that the present capacity will be increased by the proposed betterments.

The Woodstock Operating Corporation, Anniston, Ala., associated with the Woodstock Iron and Steel Corporation, will soon commence the rebuilding of a portion of its works recently destroyed by fire with reported loss of about $100,000. The damaged section included sintering plant and other departments of operation.

The Norfolk & Western Railroad Company, Roanoke, Va., is considering plans for the erection of a new steel rolling mill.

Trade Notes

The Quigley Furnace Specialties Company has opened a branch office in Providence, R. I., at 302 Turks Head Building, in charge of F. W. Reisman, who has been the Quigley Company's Eastern New England representative for Hytempite (high temperature firebrick cement) and insulating brick, ,as well as the air transport system for distributing and burning powdered coal and other fuels.

C. J. Brown, who has been connected with the sales divisions of the R. D. Nuttall Company for the past three years, has become associated with Frank M. Erb, representing in the Pittsburgh district, the Silver Manufacturing Company, National Forge & Tool Co., Horsberg Forge Company and Meadville Malleable Iron Company. Mr. Brown will be located at 902 Second National Bank Building.

Ensign Irving Burrows has been released from the service of the government and will reopen the San Francisco office of the Blaw-Knox Company, Pittsburgh, at No. 528 Second street.

The Electric Furnace Company, Alliance, Ohio, has just closed a contract with the Standard Roller Bearing Company, Philadelphia, for 190 kw continuous, automatic, heat-treatment equipment. The set consists of one 150 kw electric furnace for hardening and one 40 kw electric heated oil drawing bath. There is supplied in addition an oil-quench bath located between the furnace and the electric-heated, oil drawing bath. Material, which consists of alloy steel balls and ball races, is automatically handled through the furnaces, quench, and drawing baths, in metal baskets.

Freyn, Brassert & Co., Engineers, Peoples Gas Building Chicago, have been awarded the contract to license the Lackawanna Steel Company, Buffalo, New York to erect a Brassert gas washing and drying unit for No. 6 blast furnace. This is the fourth unit of its kind in this plant.

The same firm is also supplying an 80 foot Dorr thickener for the clarification of the waste water from two Brassert gas washing and drying units and recovery of the flue dust in connection with the installation of two blast furnaces at Rouge River plant of the Ford Motor Company.

In addition to this Freyn, Brassert & Co., are designing and building a blast furnace office and three service stations for the Steel & Tube Co. of America.

Trade Publications

The Hyatt Roller Bearing Company of New York City, has issued their latest bulletin of steel mill bearings, giving designs and all engineering data for the application of Hyatt roller bearings to steel mill cars, roller tables, and plate castors. This Bulletin No. 1815 is only temporary and is designed to place the present correct bearing data before the industry.

A Type "H" Stoker bulletin has just been issued by the Combustion Engineering Company, 11 Broadway, New York. It covers automatic stokers for all kinds of industrial and heat treatment furnaces. Over 20 years experience in building these stokers and in solving the combustion problems in steel mills of all kinds enables this company to furnish an especially interesting service as combution engineers to this class of business.

Plant Construction—A new pamphlet published by the Detroit Steel Products Company, entitled "Building Daylight and Ventilation Into Modern Foundries Increases Production," will be of interest to a number of owners, because it illustrates two widely different foundry designs. The Hubbard Steel Foundry at East Chicago, Indiana, is noteworthy because the area of the exit ventilators in the monitor was carefully figured against the area of the intake ventilators in the lower units of the sidewall, while the intermediate units were designed without any ventilation whatever. Thus a circulation of air is created, which sweeps heat and gas out of the building like smoke going out of a chimney. In the Lakey foundry at Muskegon, Mich., five runs of toprung continuous sash in the monitor takes off fumes and smoke, while an equal number of runs of pivoted sash in the sidewall admit an abundance of fresh air from outside.

The same company has also issued a new catalog, 41 pages in length and well illustrated. Pages 3 to 6 are devoted to a discussion of what types of sash should be used in a monitor. This contains valuable suggestions for application in foundries, forge shops and similar buildings where good lighting and the removal of heat and gases are problems of first importance.

Government Publications—New publications of the Department of the Interior, Bureau of Mines. Eighth annual report of the director of the Bureau of Mines, by Van H. Manning. 1918, 123 pages. Bulletin 156—The Diesel Engine, Its Fuels and Its Uses, by Herbert Haas. 1918, 133 pages, 16 plates, 57 figures. Technical paper 206—Coke-oven Accidents in the United States During the Calendar Year 1917, by A. H. Fay. 1918, 19 pages. Technical paper 208—How to Improve the Hot-air Furnace, by C. W. Baker. 1918, 20 pages. Efficiency in the Use of Oil Fuel, a handbook for boiler-plant and locomotive engineers, by J. M. Wadsworth. 1918, 86 pages, 4 plates, 17 figures. Technical paper 191—Central Station Heating, Its Economic Features With Reference to Community Service, by J. C. White. 1918, 23 pages, 6 figures. Technical paper 197—Use of the Hydrogen-Volatile Matter Ratio in Obtaining the Net Heating Value of American Coals, by A. C. Fieldner and W. A. Selvig.

Conveying Machinery—Gifford-Wood Company, Hudson, N. Y., has just issued Catalog No. 18. The catalog describes coal elevating and conveying machinery, ice handling machinery, ice tools, general elevating and conveying machinery, sheet and structural steel work and equipment for power plants, coal tipples, cement mills, coke plants, chemical works, pulp and paper plants, rolling mills, coaling stations, grain elevators, retail coal yards, ice houses, quarries, sand and gravel plants, manufacturing plants, storage warehouses, etc.

Fence Supports—Carbo Corporation, Rand-McNally Building, Chicago, has issued a folder describing and illustrating a fence supporting system. The features emphasized are the placing of the metal posts without the use of a spade, and the construction of the supports between any two terminals, designed to spring with the fencing, thus keeping the heavy forces on the reinforced end terminals.

Ball Bearings—Hess-Bright Manufacturing Company, Philadelphia, in their new bulletin, give the history of the development of ball bearings. Views are given of automobiles, automobile parts, airplanes, machine tools, flour and feed milling machinery, wood-working machinery, electrical machinery, locomotives, etc., in which the company's products are used.

Society Meetings

The Engineers Society of Western Pennsylvania will be addressed by Albert Kingsbury, Consulting Engineer at the annual meeting of the mechanical section on February 4, Union Arcade Building, Pittsburgh. Mr. Kingsbury will discuss "Experiments in Lubrication." Dr. C. E. K. Mees will address this society on February 18 on the subject of "The Camera in War."

American Institute of Mining Engineers, New York, N. Y., February 17-20.

New England Association of Gas Engineers, New York, N. Y., February 19.

American Railway Engineering Association, Chicago, Ill., March 18-20.

The Association of Iron and Steel Electrical Engineers, will hold their regular meeting at the Hotel Chatham, February 15.

Obituary

George D. Devitt, one of the oldest blast furnace superintendents in the Shenango Valley, Pa., died at his home in Sharon, Pa., January 6. He was 74 years old. For 23 years he was superintendent of the Mabel furnace, and of late years had been chief clerk for the Shenango Furnace Company.

Burt O. Gage died January 10 at Warren, Mass., aged 75 years. He had since his thirteenth year been engaged in mechanical pursuits. He was a master mechanic at 18 and since 1867 a designer and builder of pumps, being superintendent of the Warren Steam Pump Company at the time of his death.

66

FEB 11 1919

The Blast Furnace and Steel Plant

Pittsburgh, February, 1919.

INCREASED TONNAGE and DECREASED COSTS
result from the use of this highly-efficient material

ADAMITE
PATENTED

for Rolls, Pinions, Gears, Dies, etc.

THIS super-carbon alloy bridges the gap between iron and steel—it has chemical characteristics more nearly approaching iron, with physical properties equal to if not exceeding the best grades of steel.

Adamite is a hard, tough, strong material that resists wear and abrasion better than any other metal. It is made under U. S. and Foreign Patents.

Many records of actual performance, in hundreds of mills and factories, show Adamite to give several times the service of steel; greatly increased tonnage records, and lower operating costs.

WHEREVER the wear is unusually severe and continuous, it is profitable to specify and use Adamite—it has proven most efficient for rolls of all kinds, pinions, gears, dies, drawing rings, plungers, coupling boxes, and similar parts; and there are hundreds of other parts where Adamite may be used most successfully.

THIS BOOK——→ describes Adamite, and some of its many uses—ask for a copy.

Pittsburgh Iron & Steel Foundries Co.

Executive Offices: PITTSBURGH, Foundries: MIDLAND, PA.